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THE MEANING OF INTELLIGENCE

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TORONTO

THE MEANING OF

Intelligence

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PREFACE

This book brings into a focus various research findings on the broad question of intelligence; it attempts to relate technical issues to certain problems in modern life. While neither a textbook nor a handbook, it may help workers in psychology, education, and related fields who are baffled by the tremendous amount of fragmentary writing and discussion.

In the preparation of this work, I have enjoyed the steady assistance of Miss Dorothy Bradbury and Mrs. Ruth Jordan, and especially of Miss Helen L. Rhinehart.

GEORGE D. STODDARD

Albany, New York
December, 1942

TO MARGARET

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PART I

THE NATURE OF INTELLIGENCE

CHAPTER I

ATTRIBUTES AND CONCEPTS

A definition of intelligence may be expressed independently of the way in which abilities are developed in the organism. It is all right if certain elements and factors lying in heredity, organic constitution, or environmental forces are recognized as crucial to mental ability. But to *define* intelligence as a composite of inherited factors, or as a derivative of environmental pressures, would beg the question. Some persons think it irrelevant or misleading to define intelligence; they say, "Intelligence is whatever the tests measure." This may be a good cliché now, but how could it be helpful to persons starting out to build tests? At that time a test measures nothing. What does the test constructor put into his tests and why?

The need for a conceptual basis is clear when we ask ourselves, Why is it generally held that an individual test is preferable to a group test? Is the difference in validity? If so, exactly how was the validity of the modern mental test determined? Did Binet, for example, having defined intelligence in terms of the capacity to think along a definite direction, to make adaptations to a given end, and to criticize solutions, really select his tests in conformity to this trinitarian concept? While Spearman says *No*, most workers feel that Binet worked toward this general goal. Similarly for the Stanford revisions of the Binet-Simon Intelligence Scale: if intelligence is defined as *the ability to do abstract thinking*, is every test item to be judged by this criterion alone? If not, what are the points of departure from the criterion and what are the valid reasons for such disjunction?

Tied in with the meaning of intelligence is the meaning of *brightness*, that is, of the intelligence quotient or IQ. Certain assumptions underlying the concept of a fixed intelligence quotient are easily lost sight of by workers in this field. To maintain the concept of a fixed intelligence quotient for average children requires that they gain in test score (and presumably in mental power) in a precise equivalence to advancing chronological age. Bright children, while maintaining a similar relationship between mental and chronological age, are placed on an accelerating mental scale, and dull children on a decelerating mental scale. To the extent that IQ's are maintained at about the same levels, we have evidence for these phenomena. This leaves us with the question as to whether any *definition* of intelligence may include, either explicitly or implicitly, any such concept of constancy. A sound procedure concerning the intelligence quotient, as for the concept of mental ability, again calls for a careful separation of its meaning from the way in which any degree of brightness may develop in a child. A mental test is devoted to *how much of what* — not to the further questions *from what source*, and *for how long?*

In this chapter, intelligence is treated as a theoretical composite whose elements may be operationally tested. But they have not been included, save accidentally, in any existing test or testing program. Later, we shall discuss intelligence-as-measured in relation to various factors, dichotomies, and implications, attempting to make clear at each point what kind of intelligence is under consideration, in the belief that it is better to lay this burden upon the reader than blithely to assume, to the mounting horror of good semanticists, that intelligence is now and always will be — word without end!

A definition follows:

Intelligence is the ability to undertake activities that are characterized by (1) difficulty, (2) complexity, (3) abstractness, (4) economy, (5) adaptiveness to a goal, (6) social value, and (7) the emergence of originals, and to maintain such activities under conditions that demand a concentration of energy and a resistance to emotional forces.[1]

THE FIRST ATTRIBUTE

Difficulty is a function of the percentage passing. Throughout any series of mental measurements, it must increase with chronological age, so long as we postulate mental growth.

This first attribute of intelligence does not depend for its validation upon a sequence of events within the individual; it is a function of a *population.* There will be some commonality as between the growth line of a single child and a concept of difficulty derived from a child population. It would be a strange world if seven-year-olds were more able than seventeen-year-olds. Still we are accustomed to regarding seventeen-year-olds as more intelligent than seventy-year-olds. The attribute of difficulty cannot be related directly to age increments independently of what is mentally feasible for persons of a designated age. Thus, having selected a test of intelligence, we can quite properly say that the seventeen-year-old is more intelligent than the seventy-year-old, *if he performs better on the test.* Among a population of seventy-year-olds we can still differentiate between the more able and the less able and so on, down the path toward senescence.

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[1] Stoddard, George D.: On the Meaning of Intelligence. *Psychological Review*, 1941, 48, 250–260.

Nowhere throughout Binet testing is it implied that the kind of materials presented for fourteen-year-olds is more appropriate for that age than for four-year-olds. There is no theoretical reason why the same materials could not be presented to four-year-olds to see if successes could be obtained. Validity lies less in the appropriateness of materials, as judged by external cultural criteria, than in a recognition of differences in the percentage passing. So far as mental testing is concerned there is nothing that fourteen-year-olds *should* know, but there are some things that they generally do know — some problems they can solve that are too much for the four-year-olds.

The concept of difficulty, at least in its practical applications in testing, can be carried to meaningless extremes. In the early days of subject-matter testing, it was not uncommon to weight test items according to difficulty, assigning high sigma values to difficult items and low sigma values to those that pupils found easy. It was soon discovered that in tests like spelling this led to a perversion of measurement. Much credit was assigned to words that nobody could spell or ever needed to spell, while small loss was sustained by pupils who could not spell the commonest words. It was more of an academic and social sin to misspell the word *orange* than to misspell *rhinoceros*, but weighted testing reversed the order of approbation. Similarly for mathematics: a command of the simplest formulas and operations yielded small test credits, but a failure to pass a rare and thus heavily weighted item resulted in a severe penalty. Hence the tendency has been to drop all such weighting.

As we examine this impasse, what turns out to be the nature of *difficulty?* Just what is its place in a concept of intelligence? The measurement of vocabulary will afford an example. In our culture the words *orange* and *envelope* are fairly general experiences. (Still there may be whole communities in which the physical presence of an orange is a rare event, and for all I know, envelopes are rarely seen in dilapidated shacks.) These two words are the simplest ones in the vocabulary test of the Stanford Revision. The assumption is that by the age of six years the average child will have had sufficient practical or ideational contact to produce on request a simple definition. Later, he is asked to respond to such stimulations as *shagreen* and *homunculus.* This range in words from easy to hard is obviously a product of organic readiness and social experience. Is there any mental *process* which, in its flowering at the higher levels, leads systematically from a simple word like *scorch* to an uncommon word like *shagreen?* Probably not. The latter word and others like it constitute an arbitrary and steeply ascending scale for vocabulary testing rather than a higher order of abstraction and conceptualization. *Shagreen* is a simple concept for those who have had experience with this material; one can think of herders and fishermen who would have no trouble with it. Children and adults fail on it because they lack this acquaintance. The question is, Does the person who has somehow extended his experience, or his vocabulary, to include such items show greater intelligence than the one who has not? The case can scarcely be proved for a single item like *shagreen,* but it is held that the test has validity if the periphery of language is thoroughly explored, such exploration to depend not on the curious believe-it-or-not type of item but on concepts of genuine utility.

Thus we arrive at two concepts of difficulty, one of which is a necessary attribute of intelligence, the other irrelevant or even contrary. *Ability to muster increasingly rare knowledge and to solve increasingly difficult problems of any type is a mark of growing intelligence only when the behavior along all points of the continuum of difficulty fits into the total definition of intelligence.* Other things equal, it is more difficult to repeat five digits than three digits;

the measurement of this difference is accepted in intelligence testing as a legitimate indicator of growing intelligence. Since a child is asked to repeat seven digits backwards, the question follows immediately, if seven digits backwards, why not fourteen? This is still harder, but some persons could do it. (In illustrating a mnemonic device, I have repeated 108 nonrecurrent digits — the value of pi — both forwards and backwards.) It has long been known that the ability to repeat accurately long strings of boxcar numbers may occur among the feeble-minded, although it is not confined to them. Evidently the case for ascribing further increments of intelligence to this particular skill soon falls to the ground!

In practical testing, such items are cut off at a point where a steady increment in the percentage passing in a population can no longer be expected. While the relation between the ability to undertake repetitions and the ability to succeed in schoolwork approaches zero, this limitation does not help much in answering the question, Is it not a mark of superior ability to accomplish fourteen digits backwards instead of only seven? Recourse must be had to the complete definition of intelligence. Only if repeaters of fourteen digits behave more intelligently than repeaters of seven digits are we justified in saying that we are still within the mental-growth continuum. Where this is not the case, the assumption is that we have gone off the track in pursuit of some tonal, visual, verbal, or associational skill that is intellectually nonfunctional. It may have the relation to growth in mentality that big ears or long fingernails have to physical ability. At the extremes such abilities tend to get in the way; they become ends in themselves, aggregations of facts, rather than useful patterns or structures. The test for the repeater of fourteen reversed digits is a concomitant or subsequent ability to move up through arithmetic, algebra, geometry, and calculus, or within any one of these branches to move from the lower to the higher levels of abstraction. This test can be applied by any teacher of mathematics, or by any test maker, who is able to discern hierarchical levels of comprehension and to prepare test items accordingly. The true mathematician is not the memory wizard, even if their abilities overlap. He may in fact have an ordinary memory. He can be definitely inaccurate in adding the items on his grocery bill.

Difficulty in relation to general information is not easily abstracted from the composite of attributes. We discover that it is truly difficult to achieve knowledge or understanding in almost any intellectual area. The first mental step upward from verbatim repetition to a meaningful relation of these items to other items, such that system and generalization emerge, is an indicator of high intelligence. We may admit that the step frequently taken, namely not to relate these items to other items in a meaningful whole, but simply to accumulate another basketful, is a mark of low-order intelligence. At the lowest levels there will be trouble in accumulating even one basket of information, with increasing frustration as more baskets are presented. Nevertheless the distinction can be made clear. To be meaningful, *difficulty* must be truly hierarchical and not simply a broadening of the base. To the extent that the broadening of the base, as in mathematics or other systematized structures, can be accomplished only by an increase in abstraction, we have a two-way relationship between *difficulty* and *complexity.*

Complexity increases difficulty, and the phenomenon is not strictly additive. While a little information about a few things is a simpler achievement than much information about many things, the two shade into one another if a level of abstraction is maintained. Anybody who can learn the names of ten American states can learn the names of all forty-eight, and of all the counties in the states, without drawing upon new or different mental processes. His failure at such an arduous task is not likely to be more conspicuous than the failure of a more intelligent person who would shun the assignment. But this is not characteristic of the fund of information for normal persons, as Herbert Spencer once pointed out. The person with a large fund of general knowledge has absorbed it, bound it together, and utilized it in the service of problem-solving situations and adaptations. What he is unable to use in this way tends to drop out, to be replaced by other items and clusters that are more functional.

As we go up the scale of difficulty, the blockings are of a different order; they are more central, more systematic. Most persons have had the experience of entering a somewhat familiar street or territory from a new approach, or at an unusual time of day, such that, although particular items are clearly perceived, the whole situation fails to crystallize in terms of a recognizable pattern. With further contact there is no gradual clearing up of this object and that structure, but a sudden emergence of insight; everything fits into place, informing everything else: we know "where we are." The work of school children in mathematics can be shown to partake of this phenomenon. The parts of the problem and the solution may be lying around, the child perceiving them as details instead of structural units that fit together. A mental structure thus finally fitted together becomes a unit in a more advanced structure.

Here we have an intriguing problem of intelligence and the guidance of learning. Problems, assignments, corrections, and other aids applied to the sharpening of detailed mathematical processes, with little attention to this higher synthesis, produce pupils skilled in numerical manipulation who are at the same time ignorant of number concepts. A grand strategy of curricular construction could organize all the steps, illustrations, and materials designed to lead a child upward as well as outward in his abstractions. Everything from simple arithmetic to Einstein could be elaborated as a kind of mental mountain to be ascended. After all, the very earliest symbols and concepts fed to the school child are themselves the rich fruit of generations of fine minds that worked to achieve this simplicity. Perhaps this can be done in some of the physical sciences, although we face the probability of a multiplicity of peaks. To judge the heights of the various peaks in terms of mental demands, there would be a dependence upon the authorities in the respective fields. In the biological and social sciences, the problem is more difficult because more artistic. Still there is a hierarchy of meanings and insights derived from social studies, philosophy, creative writing, and the fine arts.

What would be the nature of logical error in moving up an ascending scale? For some, it would be the inability to keep in mind four or five sets of data, a failure in generalization, a lack of appropriate experience, or a structural failure at lower symbolic levels. In our present educational conglomerate, failures of content are scrambled with failures of neural tissue. Nobody knows what any child could do if presented with facts and principles in an orderly, ascending sequence with full attention to his motivational needs.

If comparative reasoning power is ever to be adequately analyzed, we shall need from the scientific and other disciplines a hierarchical structuralization of their mental demands. Theoretically it should be possible, let us say in mathematics, to erect such a structure, showing exactly what is needed in all the basic mathematical principles in order to carry on mental operations at designated levels. A failure to reach a certain height may at times be a breakdown in knowledge rather than in conceptual ability, that is, in intelligence. If, woven into the structure of mathematical operations, there is a presumption of knowledge about arithmetic, algebra, and conic sections such that well-understood pieces of knowledge are fitted in like so many bricks, then diagnostic testing should precede a general rating of intelligence.

For the young, *underlearning* and for the old, *weakness of impression* may be postulated. With advancing age there is a likelihood, but as yet no adequate evidence, that failures arise from decreasing elasticity, such that impressions do not remain clear long enough to take their place in an orderly mental sequence. The older person loses ground faster than he gains it, thus regressing to a stage that is sometimes designated "childish" — and may so appear in the gross score of a mental test. But the designation is inaccurate, for, by definition, the child is growing. If we were to indicate that two persons on a mountain were at the same contour line, without mentioning that one was on his way up, with energy to spare, and the other painfully on his way down, the picture would be distorted.

THE SECOND ATTRIBUTE

Complexity refers to the breadth or area: how many kinds of tasks can be successfully undertaken? The attributes of difficulty and complexity are related in the sense that high accomplishment is pyramidal in structure. Breadth is no new attribute of intelligence; it is inherent in the earliest attempts of Binet. Both in theory and practice it seemed inadequate to regard intelligence as measurable along a single narrow track of ascending ability. *Difficulty* gives us the height of the column representing the abilities of persons in areas of measurement that are saturated with intelligence. Without this saturation, as has been indicated, difficulty becomes a pathological variation. *Complexity* viewed merely as information in a large number of fields would constitute a variation inconsistent with growth in intelligence. All the tasks undertaken must be representative of intelligence, and it is important that they be abstract.

Thus high jumping is not in itself an indicator of intelligence, nor is a measure of it a suitable subtest of mental ability. It is true that out of the experience or observation of high jumping we could design test items abstract in type. We might start with a hypothetical situation in which a thousand boys of the same physique and motivation were set, for the first time, to the task of high jumping. The first jumps would be similar, allowing for errors of measurement and chance variations. Now if all these boys are given the task of bettering their records in the high jump, we can assume that mental factors would enter immediately. Some would learn better from a coach than others. Some presumably would not understand the coach at all, while others would soon forget or carelessly distort instructions. Some would learn little from the observation of others; some could not learn much from their own experience. As long as we postulate abilities involving observation, memory, comprehension of instructions, self-criticism, and adaptation to a goal, the factor of general intelligence has been allowed to enter. The main reason why we say that the test above, given carte blanche, is not a good one for the measurement of intelligence lies in the assumption that all these boys were equal in nonintellectual factors. This particular skill is so heavily weighted with factors of an anatomical and muscular nature that differentials in intelligent behavior would be canceled out. Also we cannot be sure that each boy would accept the goal offered by the coach or the experimenter, for intelligent behavior may consist of jumping not quite so high as possible in order to avoid physical strain. Intelligent behavior has a way of turning inwardly upon itself such that certain actions deriving from the long view are substituted for those within the immediate range. Thus in academic work, *if* genuine values inhere in the mark of "C" which are not given to the mark of "B" or "A," then a student might paradoxically work toward a "C"; for a student of ordinary ability, the strain of working toward an "A" leads into personal difficulties that are sensed as objectionable. That this is not a rhetorical question is indicated by the plight of many neurotic students whose records indicate a pressure to choose satisfactorily between alternatives equally painful.

Complexity is an attribute primarily in relation to difficulty. We may tie the two together and call the pair difficulty-complexity. They can be visualized as comprising a pyramidal (or conical) structure in the region of highest conceptualization. Any discipline can erect its own pyramid and measure persons in accordance with their ability to ascend its slopes. Typical of generalizations at the apex are Christian, Newtonian, Darwinian, and Einsteinian principles. There are no highly generalized principles within physical, biological, or social science, or in philosophical systems, that do not converge in this fashion: to master them is not a straight-up, hand-over-hand rope climb to some intellectual stratosphere, but the progressive conquering of lesser peaks. The road is long as well as steep. After Christian ethics, gravity, evolution, or relativity, the world of thought is not again the same.

Analogously, to be an artist one must produce within art forms. Regardless of his sensitivity to beautiful objects, his ability to describe them, or his encouragement of their production, a man is no artist without achievement. The concept of intelligence includes such a complexity as artistic achievement; it is left out of practical testing only because most children and adults are graphically "illiterate." Differences in this area exist and they are important. There is no question about a scale of difficulty or about differences in breadth within this medium. Again the final test lies in our theory of intelligence: Is differential achievement in art consistent with differentials in all the attributes assigned to intelligence? If it is, we are constrained as mental testers (*a*) to admit such testing analogously to the measurement of vocabulary or the understanding of sentences, or (*b*) to admit that an area of intelligence, while recognized as valid, has not proved amenable to measurement. (All this has no reference to any set of tests for the measurement of intelligence by drawings; it refers rather to the acceptability of graphic skill and graphic insight as central abilities in a concept of intelligence.)

The great artist, like the great writer or mathematician, is *ipso facto* of great intelligence. Similarly for lesser degrees of artistic ability: we leave out of graphic or plastic ability (conceived as mental growth) straight visual or motor skills, for the the same reason that such skills, while representing true abilities, are left out elsewhere. It is not that they are unimportant in the development or maintenance of the human race, but only that they are different. After all, what is more important than the regularity of digestion? Its presence is a necessary condition for intelligence. Since this is not an attribute of intelligence, it follows that, in human phylogeny, organic fitness has preceded intelligence. But any level of organic efficiency that exhibits "normality" throughout the range of maturing intelligence thereby ceases to become a chief factor in mental differentials. Bright children will show a range of stomachs and hearts from just-surviving to superstrong — and so will the dull, in scarcely correlating series. (That there may be correlates and limiting conditions in the development and exercise of intelligence is a matter to be discussed later.)

Koffka, in outlining the growth of the mind,[1] postulates not unchanging increments but reorganization of the whole structure as new abilities are added. Changes are not additive; they are reconstructive. Referring to this concept of Koffka's, Lashley[2] says: "This would outlaw the current conceptions of quantitative differences in intelligence, and the attempts to express the growth of intelligence upon a continuous scale."

It may be that, in this context, the words "quantitative" and "continuous" are misleading. All individual mental tests imply an increasing order of complexity from the early to the late chronological ages. They have never been simply additive. Nevertheless this rising scale of complexity and abstractness may be subjected to statistical controls through measures of central tendency, deviation, and correlation. So long as we know that our quantification involves hierarchies we need not be misled. Similarly we should want to measure ability in mechanics, music, or athletics along a rising scale. In a measure of general athletic ability we would not confine ourselves entirely to measures of running. In a decathlon or at least a pentathlon of achievement, each section could be continuous.

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[1] Koffka, Kurt: *The Growth of the Mind: An Introduction to Child Psychology.* Translated by Robert M. Ogden. New York: Harcourt, Brace and Company, 1925, Pp. xvi, 382.

[2] Lashley, K. S.: *Brain Mechanisms and Intelligence: A Quantitative Study of Injuries to the Brain.* Chicago, Ill.: University of Chicago Press, 1929. Pp. xiv, 186. (p. 3.)

Later we shall discuss in some detail the problem of sex differences in intelligence. At this point it may be helpful to ask the question, What concessions should be made to the sex dichotomy, or to any clearly established difference, in terms of the attributes of difficulty and complexity? Thus intelligence (female) would involve all the attributes, but their weight could be carried in tests consisting mainly of language; while intelligence (male) likewise would involve all the attributes, but include numbers, formulas, and scientific symbols. The answer is to be found in the attribute of complexity: *there should be no concession at all to sex or any other category as such.*

If it is important in human thinking and consistent with all the attributes to utilize both language and number symbols, then both are included in the definition and indicated in the testing procedure. In modern life we demand a growing edge to technology as well as to humanistic enterprises. The mental demands of the mathematician, physicist, chemist, or biologist are tied in with human advancement. Any person who is unable or unwilling to attain a certain degree of mastery along such lines, a degree which may be considered as fulfilling a concept of general intelligence, is afflicted with a form of illiteracy. Scholars-in-words have long had the advantage because every child thinks in and through words. He learns few other symbols and rarely develops facility in their use. His graphic adaptations and performances are arrested at primitive levels.

The silent motion picture may be considered as a diffuse form of the picture writing developed in ancient times. Utilizing neither word nor sound, it builds up narrative, dramatic, and pedagogical forms. It could not survive the desires of word-minded persons who demanded speech in their motion pictures. The world of pictures, like the world of sound, is essentially nonintellectual, even though the originators and producers of its forms are rightly considered, on the basis of various criteria, as persons of intellect. In the graphic and plastic arts there is a tremendous demand upon relation and synthesis. In music there is a required depth, as well as intricate symbolic manipulation, perhaps not entirely different from the requirements in mathematics.

In brief, complexity cannot be just a profile nor a graph expressing area and altitude in two dimensions. It is rather area-altitude as a dimension of a structure (complexity-difficulty) that rises to levels of greater insight. At the apex of the pyramid there will be found problems that demand the all-in-all mentality, a confluence not representative of the largest number of skills or the biggest heap of information, but of minds employed in solving the hardest intellectual problems. All the rest is correlation: substratum into superstratum — as the spinal cord to the brain or the brain to the cerebral cortex. Regardless of the height of the structure, the apex of the pyramid is, in this sense, never far removed from its base.

THE THIRD ATTRIBUTE

The attribute of *abstractness* lies at the heart of intelligence as defined. By implication it is in every formulation of the meaning of intelligence. Mental activity takes place in symbols and fragments; it is once removed from the physical, the explicit, the complete. *Difficulty* was expressed in a hierarchy of *abstraction; complexity*, in the number of symbolic structures mastered, or in the base-area of a larger structure. As Thurstone [1] phrased it:

> To think is to cut and try with alternatives that are not yet fully formed in behaviour. The degree of intelligence is measured by the incompleteness of the alternatives which participate in the trial-and-error life of the actor. A concept becomes, then, an incomplete act, a small piece or derivative of conduct which anticipates the whole conduct. By its reference to the expected completion of the act it participates effectively in the trial-and-error expression of our wants. It is in this sense that intelligence and the capacity for abstraction are identical. (p. xv.)

This process takes time, although, in the case of intuition, the time is incredibly short. It is not the hesitation that comes from confusion or the painful running down of alternates to a point scarcely less explicit than the implied motor acts themselves. Paradoxically, the least and fastest consideration indicates the highest abstraction, just as the rat is brightest that is least confused in selecting the right maze-choice. A felt need for the concrete in the solution of a problem indicates an approach that is low in abstraction. Analogously, enumeration and description, although rendered in abstract terms, do not, as processes, reach the abstract level of analysis and interpretation.

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[1] Thurstone, L. L.: *The Nature of Intelligence*. New York: Harcourt, Brace and Company, 1926. Pp. xvi, 167.

Along this line, Wells [1] holds that to represent an action or a solution, as in the ball-and-field problem, makes a greater demand upon intelligence than the actual situation. With respect to its intellectual purity, he regards this problem as lying somewhere between a search in a field and a verbal test based on hypotheses, the former situation (the "real" one) being cluttered up with evaluations, emotions, and personal involvements. Where does this distinction leave maze solutions among animals? The answer is, according to Wells, that such solutions differ from abstract solutions. One may be as difficult or useful as the other, but the one is intelligent activity and the other is not; to be intelligent is to understand a solution described in words or other symbols and to describe it so that others may learn.

However, in the full definition of intelligence, as elaborated in this volume, the ability to carry on, successfully utilizing abstractions even when external pressures and complications arise, is regarded as a higher order of intelligent behavior than abilities that remain intact only for the controlled test situation. A solution of a difficulty in direct choice or action may not involve much intelligence because of its low saturation with abstractness. The same problem presented in an *as-if* situation depends, both for statement and solution, on verbal or other abstractions. A punch to the jaw is not intellectual. A choice of "punch-to-the-jaw" as a correct solution in a five-response test may be indicative of mental power. In the actual situation there may have been a period of weighing of factors, of reflection, which was also intelligence-in-operation, but the quality of such operations would not be measured by the punch itself or its effectiveness. Nothing grossly physical need ever be required in an intelligence test, even though overt physical acts may be to the individual a logical outcome of his thinking.

This principle can be extended to emotional, attitudinal, ethical, and religious realms. Mental ability may assist physical ability, but to keep in good health is an animal-like need shared by persons at all levels of ability. Mental abilities will make themselves known in a better formulation and comprehension of the total problem, for example, in the relationship of diet, exercise, and germs to physical fitness. Since the attributes of intelligence are entirely in the world of the abstract, it is not unintelligent to be ill; to be incapable of learning the rules of health is another matter. There will be found a correlation between health and intelligence (apart from the regression of mentality upon organic fitness), since to know better is a common prelude to doing better. For the person who knows about the prevalence of germs in open pools and streams, it is hard to take a drink of water from sources he considers "suspicious." If the ignorant or unintelligent person has no such qualms, illness may be the price of his deficiency. The objection may be raised, however, that given a hundred persons, all of whom know about the dangers of typhoid infection from a particular stream, it will be the most intelligent person who will longest resist drinking. This I regard as a dubious proposition, and in any case as a peculiarly inept intelligence test; it can scarcely be set up, much less scored. For example, if the choice is between the danger of typhoid and the risk of dying from thirst, everybody will take a drink — there will be no distribution of intelligence or any other factor in human choice.

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[1] Wells, F. L.: The Plan of Search at Various Levels of Abstraction. *Journal of General Psychology*, 1939, 21, 163–185.

In any literate country, such as the United States, almost everybody has experience with spoken and written words. Words carry the chief symbolic relationships, the chief abstractions. To fail with vocabulary is to fail with a prime tool of thought. This does not mean that vocabulary tests as they stand show the greatest saturation with abstracting ability. Perhaps the important thing about vocabulary in relation to intelligence is both the number of words known and the number of different meanings that can be thought of for any given word. Which testing procedure gives the surest penetration into the richness and depth of one's symbolic relationships?

A mental problem and its solution are no particular pattern of words. Yet *some* kind of symbolization is required (*a*) to state the problem, (*b*) to attack it, (*c*) to solve it, and (*d*) to report upon it to others — if the problem is within the scope of intelligent behavior. Thus, for most human beings, spoken words alone, together with gestures, comprise the complete abstracting equipment. Fortunately many problems are physical, motor, emotional, or traditional in character — soluble without the trying, weighing, accepting, rejecting processes that characterize cerebral primacy.

The strange thing is that the search for "the seat of intelligence" should be so much more diligent in anatomy or neurology than in the forms, limitations, and opportunities of language itself. Confined to certain linguistic customs, a whole tribe — or a race, for that matter — may become feebler in intelligence than comparative anatomy would lead one to expect. We are tempted to say that the same gray matter in English is superior to that in Cherokee, forgetting that as such speech differentials enter the awareness of growing children, the cortex is itself changing its pattern of development.

A special committee of the Modern Language Association of America [1] has held that thinking is limited by one's control of language symbols and by the categories available within a given language. Thus in English we require number and tense, while in some languages these are not specified. A language may move toward descriptive proliferations without changing its fundamental structure.

That the structure of language and the final elevation of thought may be related is apparent from observations of primitive language forms. This can be illustrated by an example from Lévy-Bruhl:[2]

> A Ponka Indian in saying that a man killed a rabbit, would have to say: the man, he, one, animate, standing (in the nominative case), purposely killed by shooting an arrow the rabbit, he, the one, animal, sitting (in the objective case); for the form of a verb to kill would have to be selected, and the verb changes its form by inflection or incorporated particles to denote person, number, and gender (as animate or inanimate) and gender again as sitting or lying, and case. The form of the verb would also express whether the killing was done accidentally or purposely, and whether it was by shooting — and if by shooting, whether by bow and arrow, or by gun. (p. 140.)

We have in such language forms genuine deterrents to abstraction; we have enumeration and description raised to the *n*th power at the expense of the logical concept. Such language is a burying ground of intellectual activity. Since language by accretion may become a tradition — the habit of great masses of people over long stretches of years — it is clear that few genetic or physiological variations need be postulated to account for large mental differences as measured in cultural behavior. Whatever interferes with the symbolizing process, whether it be brain injury, cult, or language form, reduces intelligence in the individual and in the social group to which he belongs.

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[1] Fries, Charles C.: *Language Study in American Education.* New York: Commission on Trends in Education of the Modern Language Association of America, 1940. Pp. 40.

[2] Lévy-Bruhl, Lucien: *How Natives Think* (*Les fonctions mentales dans les sociétés inférieures*). Translated by Lilian A. Clare. New York: Alfred A. Knopf, [1926]. Pp. 392.

The attribute of *abstractness* may now be placed in relation to its antecedents, *difficulty* and *complexity.* It is abstractness that is intellectually difficult. A loosely knit group of mental structures forms the colony that may characterize complexity. A unified structure, bringing many such structures into relation in terms of higher abstractions, is the final merging in *difficulty-complexity-abstractness.*

It will now be shown that the nature of these processes partakes at once of logic, symbolic tradition, and organic modification.

How logic determines the availability and the rectitude of scientific forms is described by Dewey.[1] Popular speech calls for few conditions or qualifications; a scientific statement, on the other hand, gains precision and power in the observance of logical precautions. The scientist sets up a proposition or hypothesis in such form that various conditions can be subjected to validation. The outcome is indeterminate until all the terms have been defined and all the conditions placed in appropriate interrelationships. Will arsenic poison a person? Yes, says the man in the street. It depends, says the scientist. Dewey holds that the essence of a scientific approach lies not in the establishment of invariable sequences, but in a relation of characters that permits symbolic formulation. An equation, when available, is nonexistential, even though it helps to control the nature of practical experimentation.

That maturity of abstraction will not progress evenly in each symbolic medium, has been brought out by the studies of Cameron.[2] The drawings of adults were found to be like those of children. The representations of familiar subject matter by intelligent and scientifically trained adults is remarkably immature. Cameron holds that maturity of thought in any medium is a function of social influences. If an activity is abandoned in childhood it may remain at a low level, reappearing as a primitive skill in adulthood. Similarly beliefs and mental processes may hold out against adult experience. Since a man may think like a child, it appears unnecessary to search for fundamental differences between the two.

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[1] Dewey, John: *Logic: The Theory of Inquiry.* New York: Henry Holt and Company, Inc., 1938. Pp. viii, 546.

[2] Cameron, Norman: Functional Immaturity in the Symbolization of Scientifically Trained Adults. *Journal of Psychology*, 1938, 6, 161–175.

The crux of the matter lies in the idea that reactivated functions may carry on at arrested levels of development. Could this apply also to music, mathematics, or economic principles? Perhaps what we designate as adult intelligence is a proliferation of symbolic behavior in the direction of school, vocational, and recreational experience. The result of measuring an adult's intelligence by the effectiveness of his drawings, or by his knowledge in other arrested, discarded, or deteriorated areas, would be to reduce our normative expectations. Do drawings, however analyzed, square with the present definition of intelligence? Is there a necessary incompatibility between development along one line and development along another? For example, has it been necessary to drop visual representation, as in drawings and graphs, in order to reach a high facility in words? If vision is a dominant sense in man, in the respects outlined above, why has it been so completely outdistanced by a verbal facility that depends chiefly on sound?

Everyone reads visual images, as in photographs, cartoons, paintings, or motion pictures. Having responded to them we translate in words — describing the picture or painting, with no attempt to transfer either image or idea within the medium experienced. Such an attempt would usually fail, as Cameron shows. Very likely analogous attempts in the language arts would show conspicuous failures, since reading ability is far in advance of writing ability. In ordinary conversation, which few persons lack, this deficiency is overlaid by a long familiarity with common speech forms, gestures, and concepts as easy on a cerebral cortex as the smooth running of an old rat-maze. Presumably if the school or the culture demanded it, graphic forms could be utilized in social exchange. The dual postulate is that arrestation

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in drawing is a common occurrence, taking place at low levels of abstraction, while verbal deceleration is delayed and confined to somewhat higher abstraction levels. Among adults, speed of addition or of crossing out letters has been allowed to lie fallow. Vocabulary and immediate recall run a like course, except for students and professional persons. Since much of the content of "intelligence tests" may in this sense lapse, an adult can say: "Really, I have not tried to keep up on all these little games and conundrums." It has been observed often that current society exhibits simultaneously the primitive, the medieval, and the modern scientific spirit. It is revealing and important to know that any man within himself, as he shifts from one intellectual area to another, may display reactions covering a range equally great.

THE FOURTH ATTRIBUTE

Economy is another name for speed — the accomplishment of the most mental tasks in the least time. In the solving of problems, it calls for early good choices. It is essential that the speed of forming insights pay no premium whatever in terms of errors made. Intelligence is inversely related to the habit of doing things wrong, or to a show of speed unrelated to the validity of mental processes, or the accuracy with which goals are achieved. It would be more intelligent to derive the Darwinian theory of evolution in seven years than in seventeen, on the supposition that in the remaining ten years an intellect might go on to further achievements. Since the human race over several thousand years of recorded history had failed to reach such a mighty generalization, its development was a very great feat. Its formulation by Darwin, as by Wallace, was one of the fastest insights ever achieved. An original law or principle, whenever achieved, may be considered fast, for all the previous lifetimes of experience and effort had failed to make the discovery.

When we designate *economy* as an attribute of intelligence the main consideration is not the long-time activity of the individual or of the race, but the analysis of what actually takes place during the attack on a problem. In working toward complicated solutions many things must be "held in mind" at the same time. Too much motion along a wrong line or too much delay will interfere with the ability to arrive at solutions. This slowness betrays a wallowing in which the essential items or relationships get out of focus. Everybody has experienced this in the first attack upon a difficult problem: there is a necessity for going over the ground in order to fix certain facts, relationships, and principles, while adding to the altitude and complexity of the mental structure. One difference between oral and written arithmetic lies in the strong visual reenforcement given to a mental process when written down; the sheer necessity of keeping facts "in mind," except to eidetikers, interferes with their availability.

Economy, then, appears to be a better word than *speed*, for speed implies fast motion without sufficient stress upon direction and accuracy. Economy implies fast motion which is at the same time effective. The light comes earlier, but is a true light along the pathway to solution.

In applying this principle to testing, we observe that some tests of generous time limit are nevertheless "speed tests," for they present complicated problems with elements and options that call for economical arrangement, selection, and rejection within a mental framework. A slowness, a discreteness, a schizophrenic "stickiness," all serve to block the way, dissipating whatever amount of time is available. While there is evidence in child development that solutions once reached are equivalent, whether the time required was long or short, time differentials will afford a basis for predicting ultimate intellectual ratings. So long as the preceding attributes are safeguarded, the fast thinker will be judged superior to the slow thinker. If they both reach a given goal, the former, having arrived first, can accept further assignments involving growth in difficulty or complexity.

THE FIFTH AND SIXTH ATTRIBUTES

The attributes of *adaptiveness to a goal* and *social value* tend to merge. For a given temporal-social locus, cultural values are understood, even if changing. The individual child or adult must accordingly apply his mental processes in behalf of what is approved — to whatever is believed by the social group, rightly or wrongly, to be contributory to the general welfare. Thus a monastery may be populated by devotees who would build up ratings of *intelligence* consistently with their ideas about adaptiveness and social value. Regardless of the test content revealing these attributes, the first reference point is to individual behavior and the second to the more slowly changing mores.

Individuals differ from one another in adaptive behavior, and they differ from their own previous selves as occasion requires. The emphasis is away from unlearned or "instinctive" behavior that may characterize a species in a rather fixed fashion, and toward a tentative, implicit withholding behavior that reduces false commitments. It is a mental trial-and-error, conceived not as a mechanical or temporal linkage, but as units to be accepted or rejected under certain conditions of mental set. The end result may or may not be discernible in physical or external behavior; as often as not it will rest in a mental solution that gives "peace to the mind." This contentment will last until the problem changes or merges into a larger problem.

A soldier retreating from the enemy stops to bind his foot in order to continue his escape, the process calling for elaborate adaptations that he must think about as he moves along. If his thinking is done fast, with so little of mental trial-and-error as to be quickly lost from consciousness, we say that he has performed his actions intuitively. As Rignano[1] has shown by effective illustrations, intuitions are not different from other mental processes except in the attribute of economy. When thinking is fast and good it scarcely seems to be thinking at all. Where it is good but painful and laborious, we are acutely conscious of the process. Indeed we are likely to confuse the effort expended with the process itself. It is as if one were to say: "This solution must call for a high level of intelligence because I have had so much trouble with it." Unless we have an external measure of difficulty, this obviously begs the question. A great amount of trial-and-error preceding insight is not in itself an indicator of the level of adaptiveness required by the problem.

It is not enough to perform speedily difficult and complex tasks. There must be a goal, a purpose as against aimlessness, and plasticity as against rigidity. To repeat a long series of digits, under standard conditions of testing, is difficult. Under similar controls to perform other tasks, as in defining rare words, solving problems in artificial language, or mastering compact scientific arguments, is to draw upon the attribute of complexity. Since all these skills deal with abstractions, to perform these tasks speedily is to meet four of the attributes of intelligence as presented above.

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[1] Rignano, Eugenio: *The Psychology of Reasoning.* New York: Harcourt, Brace and Company, 1927. Pp. viii, 395.

Few persons would feel satisfied to consider the area of intelligence now fully enclosed and the area of nonintelligence fully excluded. However, what must go into the definition from this point onward has always suffered from vagueness. Psychologically its nearest equivalent is in *purpose* or *mental set.* Intelligence-in-action has a sense of direction. There is something to be accomplished. At some point a problem is solved, a decision is made, a relation is "seen" — all to be followed by an attack on further questions, or a period of quiescence. There is a searching that may be disorderly but at least expresses the highest organization that the person can apply to the task as he sees it.

Here Dewey [1] is helpful in demonstrating the inadequacy of any theory that "identifies stimuli with a succession of specific sensory excitations." It could not account for an animal stalking its prey, for this would substitute immediate objects and small events for the characteristic goal-seeking drive. Nor can one regard common reflex activities as proper building stones in a structure that must grow in an integrated fashion; at the most, says Dewey, they are highly specialized end points or developmental by-products.

Thurstone [2] has held to a consistent point of view in asking that we "dethrone the stimulus." The individual wants and drives are paramount; they will seek stimuli and utilize them to attain appropriate ends. As we go up the scale of mental activity the possibility of delayed choice increases, thus allowing the organism, as it were, to bring to bear upon any problem more light from its nervous system.

Intelligent behavior is never busywork. It is always geared to a problem, a project, a goal, a need. In practical mental testing the ingredient of *adaptiveness to a goal* is carried in an oversimplified fashion. We present something that conforms to a shadow or pale duplicate of what occurs in "real" life. For example, a child will undertake to perform three commissions, usually without much restraint or rebellion. While he experiences a mild satisfaction in successful completion, he does not feel a pressing need to perform the commissions. His own fundamental wants are rarely involved; he will perform mentally only what he can do easily. This is said in full recognition of the fact that, in the extreme case, a personal involvement may act as a mental deterrent, setting up emotional activities not helpful to reflection. The testing situation suffers from a hiatus between its demands and the full resources of the individual. The "life" situation, except for persons well below average, tends also to demand less of the individual than could be delivered.

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[1] Dewey, John: *Logic: The Theory of Inquiry.* New York: Henry Holt and Company, Inc., 1938. Pp. viii, 546.

[2] Thurstone, L. L.: *The Nature of Intelligence.* New York: Harcourt, Brace and Company, 1926. Pp. xvi, 167.

Here we meet another paradox. It is among the able and the ambitious that a severe discrepancy between felt need and delivered power makes its appearance, leading to frustrations and pathological involvements. These involvements are thinking-gone-astray, rather than an absence of thinking or low-level thinking. The dull, the humble, the spiritless are less likely to get caught in this particular web of maladjustment. At the extremes they will be confined in institutions for the feeble-minded, for failure to comprehend their personal and social obligations. As the late O. Fred Boucke used to say: "To the simple-minded, all things are simple." But more intelligent persons discerning differences in social status, sampling the flavor of a highly abstract life, push themselves, or get pushed, into difficult or impossible situations. In the attempt to escape from these they may become *mixed-minded.*

Why then do we keep the distinction between the feeble-minded and the insane? The answer lies in differential etiology, symptomatology, and therapeusis. Moreover, the feeble-minded are easier to take care of. They are, by definition, more docile and tractable. Having been discovered in their earlier childhood days, they can be subjected to a special course of vocational training that yields some economic returns to the state. For the psychopathic involvements the reverse is more often true. They may result from an increasingly complex social and emotional life or from tissue defects that, for the majority, are not immediately observable. Bolles and Goldstein[1] have observed: "The difference between the schizophrenic patients studied and normal individuals lies in the capacity for abstract behavior. Both the normal and abnormal show concrete behavior in certain situations where concrete behavior is adequate. . . . The abnormal proceeds in a concrete way on all sorting tests." (p. 24.) The schizophrenic's capacity for abstract behavior is impaired. It is to be noted that these patients showed high general intelligence and ability "in so far as concrete behavior was involved. There was no evidence of mental deficiency from the history. If we do speak of a defect of the intellect, we must speak of a special type of defect, characterized by a failure in all performances which require abstract behavior." (p. 23.) Such a defect is a tremendous failure in intelligence! The better the tests, the more sensitive they will be to this type of mental aberration.

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[1] Bolles, Marjorie, and Goldstein, Kurt: A Study of the Impairment of "Abstract Behavior" in Schizophrenic Patients. *Psychiatric Quarterly,* 1938, 12, 42–65.

Legal definitions of insanity usually include such statements as "a defect of reason," "unsoundness of mind," "no longer capable of understanding or acting with discretion in the ordinary affairs of life," or "destroys the understanding." They resemble the British and American definitions of mental deficiency, except that these emphasize general defects appearing at birth or in early childhood. A mentality that has never matured is *feeble;* one that has come and gone is *senile;* one that, previously passing as "normal," has gone astray, is *insane.* Since in none of these situations is the power of abstraction intact and dependable, intelligence will be comparatively low. But the law rightly holds that "mere imbecility or weakness of mind, however great, is not 'insanity.'" Practically, the imbecile can be adjudged "insane" only if he becomes destructive or dangerous.

All psychotic involvements reduce the intellectual level, perhaps to ratings not above those of the feeble-minded. When this happens the insane person is also feeble-minded, differential social or medical diagnoses being maintained only for purposes of therapy and legal classification. This type of involvement may be illustrated by a case history from Despert.[1] In this case are we not justified in a diagnosis of mental deficiency accompanying abnormality?

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[1] Despert, J. Louise: A Comparative Study of Thinking in Schizophrenic Children and in Children of Preschool Age. *American Journal of Psychiatry,* 1940, 97, 189–213.

> On admission the patient (a girl, age eight years, six months) was found apprehensive, uncooperative, hiding when other children were ready to go to school, exceedingly affectionate toward nurses, but not responding to their requests regarding routine, asking innumerable and irrelevant questions, often in answer to nurses' questions. Visual hallucinations were described as water balls which came to see her every night and bothered her during the day, such as when she tried to do her arithmetic. "They have keys instead of eyes. They want to know what I am doing and thinking." She stated that she would not let her parents die, would set the clock back to make their ages go backward, would keep their eyes open or paint pictures of them to keep them from dying. In her contact with children and adults at the hospital, her speech was disconnected, rambling and irrelevant, but her preoccupations and fears were more clearly formulated. The psychometric test, giving her an I.Q. of 75 on the Stanford Binet, was not considered valid because of great variability of response, especially in those parts requiring comprehension and reasoning. The character of the scale and the ability to read in accordance with her chronological age pointed away from the possibility of the child's being of defective native intelligence. The lowest score was on the Goodenough drawing test when the child made three drawings of a man which were bizarre, poorly coordinated and unlike those of defective children. A Rorschach test confirmed the absence of congenital defect and stressed the "characteristic intellectual difficulties and lack of mental control in the absence of emotional tension as well as the seriously weakened inability for meaningful deep emotional experience." The physical examination, including neurological and laboratory data, showed normal findings.
>
> The patient was paroled to her parents in an unimproved condition after one year and eight months. During her stay at the hospital there was no essential change in her behavior. At present (age 10 years, 10 months), she attends school, often under threat of being returned to the hospital, does poor work scholastically, is frequently day dreaming, plays alone (locks herself in the bathroom when group games are organized), and fights with her younger sister frequently and without provocation. (pp. 193–194.)

Here we have an illustration of the possible utility of the present attributes along the lines of inclusion and exclusion of test results. A child who shows great variability in the quality of his comprehension or reasoning, who cannot or will not make full use of "innate ability," is, to the extent measured, unintelligent:

> We shall never arrive at any clarity if we allow *causes* for variation to be confused with the concept under consideration. Thus *running*

> *ability* can be well measured under standard conditions. Among those with low running ability quotients would be found the lame, the fat, the ill, the decrepit, the untrained, the uninterested. But we must stick to our measurement guns — there is no point in estimating how they could have run, shorn of these disabilities. That may be the coach's job, but the tester is the timer. Similarly, it would be a theoretical and practical advance, if mental abilities could be analyzed and combined in conformance to some clear ideas of what we are trying to do.[1]

A choice that swings the child away from the course of straight thinking is, in and of itself, an intellectual inferiority. The Coolidges who do not choose to run or the Ferdinands that do not choose to fight should not thereby be proclaimed as good runners or good fighters on the ground that, *if* they had run or fought, they would have done well. There is no such thing as a child who can solve a problem "if he wants to," unless over a reasonable sampling of time and situation he shows such intention.

Under abnormal conditions persons may develop special symbols and relationships. These are similar enough to the concepts of other persons to permit codification, as it were, so that the practice of psychiatry is not without its scientific and empirical backgrounds. Similarity in abnormal behavior is to be expected in view of the common pool of experiences and frustrations available in a particular culture. The pathological contents are formed from fragments themselves considered normal. From the standpoint of intellectual process, the abnormality consists in a failure to make appropriate adaptations, to achieve a necessary concentration, and to arrive at solutions that are considered acceptable. The abnormal departures, although noticeable, do not lead to institutional or other restrictions until they reach areas defined and protected by social custom and legal formulation. A person's mental peculiarities are tolerated so long as he does not steal, burn down houses, attack other persons, or fail to earn a living. The stake of society in psychopathology arises from its strong sense of self-protection. This protection is sought by "cure" or confinement. A mental aberration tends to get under one's skin; it is not an aberration if it is only a difference devoid of social sting or personal embarrassment. Abnormality is a form of mental untouchability that alienates the sentiments of friends and relations. Anybody who can cope with such cases is given the highest professional rating. This accounts for the respect bordering on awe which people feel for mental hygienists and psychiatrists. They are the real magicians of modern life, for they are called upon to tinker with and set straight the most delicate mechanism known to man.

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[1] Stoddard, George D.: On the Meaning of Intelligence. *Psychological Review*, 1941, 48, 250–260. (pp. 253–254.)

THE SEVENTH ATTRIBUTE

The *emergence of originals* is included as an attribute because of its special place at the upper end of any valid distribution of intelligence. While related to high ratings in the six preceding qualities, it is not an inevitable outcome of such ratings. It might be misleading to state that the emergence of originals is characteristic of genius, although that is a partial truth. It is characteristic of high-level thinking well below the genius rating. The whole concept of genius will bear further inspection, and in this volume it is treated in Chap. XII. Clearly originality is in a class by itself. It is difficult to think of any continuum to which it may belong. It is not so much *more of something* as it is *something new and different.* In engineering it becomes the discovery of a new principle or design. The greater the break with old learning or tradition, the more the ingredient of originality may be considered operative. Refinements of a standard principle, or its application in human affairs, may or may not enlist mental activities at highly original levels.

A common question is whether or not originality inevitably springs from a combination of the abilities generally found in mental tests. Certainly the emergence of originals is given no credit whatever in Binet testing. A truly extraordinary definition of *pity* or *justice* or *charity* carries with it exactly the same credit, that is, the same assignment of mental age units, as a definition that is barely passable. From a clinical standpoint the better definition is revealing. Practically, however, if that kind of evaluation is helpful, it will be necessary to provide for it in the test itself. While there is a mild relationship between the better definitions of words and the ability to define the words at all, this illustrates the unsatisfactory role of tests in the discovery or rating of originality.

It would be an error to regard originality as a desirable, but detached, frosting to the layers of intelligent behavior. Rather, everything is in everything else. As Herrick[1] remarks, consistently with Thurstone's central thought on the nature of intelligence:

> The human type of plasticity of behavior is the very antithesis of habit; it is a new vital mode, though its rudiments are readily discernible in the rat's capacity to form new habits. New vital patterns have come in at every turn of the road of evolutionary progress, for evolution is creative in the sense that the elements of organization are recombined in original ways at every transition from type to type. This is a natural process and demands no appeal to mystical or supernatural agencies. (p. 350.)

THE PLACE OF CONCENTRATION

Two further conditions identifying intelligent behavior should now be cited. The first is a *concentration of energy:*

> [it] postulates a selecting, rejecting, recombining process moving in the direction of larger goals; sheer accumulation of information is the antithesis of intelligent activity. Intelligence, feeding upon an amorphous mass or an endless aggregation of facts, bogs down. It begins to look strangely like the "standard" school curriculum which, by overwhelming the pupil, teaches him to accept a half knowledge about a thousand things as superior to a full and clear understanding of certain basic principles in human knowledge and behavior. It enshrines half-learned, soon-forgotten details while neglecting the few dozen basic principles in the physical, biological and social sciences that could forever inform and delight the inquiring mind. It is keen on *knowledge about,* and cool toward insight and participation.
>
> Out of school, the failure to grasp the real significance of *intelligent* behavior leads to a wallowing in "mental stunts," to cross-word puzzles, to question-and-answer superficiality. If such activities are carried to extremes, that is to say, beyond their preserves in harmless pastime, the whole effect is to make a wastebasket of the human mind. It is not in facts *per se,* nor in the first person, place or chronology that comes to mind, but in their relationship to generalized principles and to goals in human development and behavior, that order appears out of chaos.
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> In a world that, in and out of school, has developed contact and communication to a marvelous degree, this attribute of intelligence

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[1] Herrick, C. Judson: *Brains of Rats and Men: A Survey of the Origin and Biological Significance of the Cerebral Cortex.* Chicago, Ill.: University of Chicago Press, 1926. Pp. xiii, 382.

> appears crucial. It is a guard against mental indigestion. Perhaps it can be framed as a question: how many hours has this person devoted to the systematic exploration of any mental question? That such expenditure of energy is related to motivation, is obvious.[1]

At the extreme of indiscriminate "mental intake," we can be sure that the attributes of abstraction and originality have been weakened. We cannot safely omit reference to this ability to stay long with a problem, for we are concerned chiefly with measuring the child. We want to know what he will do when confronted with a problem whose solution is within his power, provided he is, or can be, adequately motivated. The child whose thinking is economical is rated higher if, having saved time, he utilizes it in the service of further mental problems. Even when a solution is approached, a child may abandon the task. Similarly for many adults, sustained effort, either physical or mental, is a gloomy prospect.

Concentration at the moment is distinguished from concentration expressed in a long sequence of symbolic tasks. The first is related to mental set. It is possible, but not established, that a deliberate arousal of muscular tensions would improve learning, thus permitting a higher score in any test calling for learning at the moment. It is noteworthy that a series of failures to learn at the moment, as in the child's lost opportunities to learn the meaning of words, is designated subsequently as a failure in "intelligence." Having failed to learn, the child gets a low mark in an intelligence test. This test behavior is then considered by some persons as a sufficient reason for failing to learn in the first place! The circularity of this argument should be apparent. The original failure to learn *under proper conditions* is indeed a mark of low ability, assuming that the required learning is within the area of our definition. Rarely at that time or later is there any inquiry into the conditions under which the learning was attempted, or of the child's previous experience with avoidance or failure. It follows that, as we pass from one child to another, the particular mental age or IQ estimated from testing may represent widely different abilities. For some, it is the top endeavor; they succeed in an all-out attempt to reach a given level. Other children measured as mentally equal may be displaying minimum powers. These statements are not dependent upon the rapport between tester and child, for it is assumed in both cases that rapport has been excellent.

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[1] Stoddard, George D.: On the Meaning of Intelligence. *Psychological Review*, 1941, 48, 250–260. (pp. 256–257.)

This condition of concentration, considered in both immediate and long-range application, is poorly provided for in standard mental testing. Attention is demanded in the repetition of digits or the paraphrasing of proverbs, but it is sure to be short-lived. At no point throughout the whole range of the Stanford-Binet Scale (Year II to Superior Adult III) is a child or an adult expected to devote more than a few minutes to a given task. Often the outcome (success or failure) is a matter of a few seconds. The kind of testing or clinical procedure that could be set up to include *concentration* will be mentioned later in the discussion of measurement.

A RESISTANCE TO EMOTIONAL BLOCKINGS

The second extension of the concept of intelligence calls for a resistance to intrusive emotional blockings or distortions:

> While emotional forces are excellent in their time and place, they play havoc with the decisions and actions that depend upon logic and objective relationships. If 2 and 2 are ever to be anything but 4, the change must be brought about by mathematicians, not by ignorant or neurotic persons who dislike 4.
>
> The whole question of propaganda is a case in point. The propagandist conceals his intentions and tries to establish relationships in your mind that could not be tolerated if all were known. This is done presumably for your welfare. In other words, you are not to be trusted with full knowledge, for you might come to the wrong, (that is, right) conclusions. It is a mental legerdemain employing labels, symbols, dark rooms, and favored gestures and traditions. It is not necessarily a result of international crises, although these may widen the scope and increase the deadliness. Since emotion-arousing labels are a stock-in-trade, any person, other things equal, is intelligent to the extent that he remains undeceived.[1]

Emotional blockings may operate in a direct physiological fashion. High anger and high thinking are mutually inconsistent as simultaneous processes. Also the insertion of a period of strong emotional involvement in a chain of responses will have deleterious effects. Men share with the lower animals the phenomena of inhibition, disturbance, and erasure. We might suppose that among "logical" people there would be a high correlation between the strength of a belief and the mass of the supporting objective evidence. Actually, except among the most severely disciplined scientists, the reverse is true. Emotion is not an emergent from facts or evidence. It is "a thing of shreds and patches" that gives the ego a lift while the mind is absent-without-leave. The emotional content moreover may be small and yet incredibly effective in sabotaging the intellectual process. Persons cherish false relationships, *non sequiturs*, and contrary-to-evidence beliefs that are pleasant. While retained with a mild feeling-tone, these often would be abandoned only under severe emotional stress. The strength of such blocking can be estimated from the total force that would be mobilized against change. Thus we say of a person, "His beliefs were shaken," meaning that *he* was shaken through the necessity of their relinquishment. The mental ship clings fiercely to its barnacles; it will go to almost any lengths to avoid a scrape!

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[1] Stoddard, George D.: On the Meaning of Intelligence. *Psychological Review*, 1941, 48, 250–260. (pp. 257–258.)

Feeble in mind are the persons whose intact brains, giving the highest promise up through childhood (as shown by insight into school subjects and other relationships), have been so systematically drugged with the vapors of dogma, superstition, and pseudo logic as to fail at the lowest attribute levels. They live in a mental darkness of their own choosing. If this seems farfetched, it is necessary only to examine the futile activities of good brains — the best of their time, and surely not inferior in tissue potentiality to those of our era — during a full thousand years of human history. These dark ages persist in a land of marvelous mechanics and universal education. Mark out an area from which scientific methodology is barred and you have encompassed the happy hunting ground of primitive tradition, dogma, and propaganda.

What is needed is science and logic, together with a forthright, truth-seeking honesty. We shall then know our fables for what they are; we shall retain them if they serve a generally recognized social purpose. As make-believe, as fantasies, they could become revealing, encouraging, and dramatic — fiction known for what it is, and enjoyed accordingly. The current, deep-seated mental dishonesty comes about through a conspiracy in support of their designation as fact beyond the demonstration of fact.

Thus throughout the world of religion, a mature intellect is expected to embrace concepts and relationships abhorrent to the inquiring mind of an average child. Since the mind can never be truly compartmentalized (except under pathological conditions and then only relatively), *logical defects in these protected areas weaken the total mental structure.* The scientist is not quite a scientist if any portion of his intellectual mechanism is set apart for special irrational activities. Among ordinary children and adults, the infection is faster and more certain. On the intellectual level, the main deterioration is in the wearing smooth of mental cul-de-sacs. To sign the party pledge is to lose a spoonful of live gray matter. After all, the mental defective, being in error at a low level and therefore soon disregarded, is not the discoverer or stamper-in of error. It is the physiologically intact minds, sure of themselves, bathed in an accepted culture, that go astray along lines inimical to straight thinking — the world's fanatical leaders who press down upon others a devastating social inheritance. Man-made concepts, such as *devils*, *witches*, *totems*, *taboos*, *hell-fire*, *original sin*, *divine right*, *predestination*, *reincarnation*, *salvation-through-death-in-battle*, and *divine revelation*, related to no genetic patterns, but kept alive in an unending chain of emotionally tinged spoken and printed words, have distorted the intellectual processes of millions of persons over the centuries. Apart from the negative intellectual influence, the effect upon human welfare, let us say in peace, personal adjustment, and social progress, has frequently been unfavorable. In factional fights for salvation, salvation itself sinks into the background. Nowadays few social or religious institutions among civilized countries press their ideological points beyond a mild lip service that is not inconsistent with personal and social amelioration. Systematic thought has congealed into a mold, making it unnecessary on the part of the parishioner to give it much concern.

Outworn religious theory, while a great sinner, does not stand alone. Thus, when a scientist seeks and obtains his satisfactions in the selection of the precise invectives (in modern terminology the right "smear-words"), it is time for every student in the field to give heed to this danger signal. The feelings and emotions aroused in the pursuit of objective truth are mild, but they are satisfying and durable. They should not be denied to the scientific worker. But these are easily distinguishable from outbursts, often disguised as moral indignation, that are in essence explosive defenses of one's own position. They may take the form of malicious attacks upon all persons who disagree. Our present concern with this phenomenon is to discover to what extent defense mechanisms interfere with the maintenance of intelligent behavior and with the delivery of its force at any given moment in any designated area. Some persons are unintelligent because of marked organic inferiority that may have existed from birth or earlier, and may have been the outcome of unfortunate gene combinations. They become "public charges." The mental defectiveness arising from emotional sources is equally a charge upon the public, for it plagues many individuals who have already assumed posts of responsibility. Their failures are more charged with social disaster than those of the child who is baffled by the elements of reading.

A commonplace example of an intrusive emotional blocking is the designation *Democrat.* Possibly it could be established that, in Maine or Kansas, genuine and acceptable truths directly out of the mouths of Democrats would be discounted. Such disparagement, by definition, is a retreat from intelligence. The validity of a statement of fact is unrelated to the political affiliation of its exponent. Different sections of the country, different cultural strata, races, nationalities, sexes, and clusters of individuals will vary in the sources of emotional intrusion. The way to discover intrusions and blockings is by survey, experiment, and demonstration. They do not exist on a priori grounds. We have an attribute that can be measured, but no factor discoverable in mental organization. A factor, at its best, has a sense modality; at its vaguest, it is an artifact arising out of heterogeneous conditions in age, experience, sex, race, and test material. An attribute such as *economy* differs in degree from person to person, material to material, and time to time, and can be so measured. Large swings in trend lines can be distinguished from casual shifts. If everybody "forgot" at the same rate, mental ability would decrease in variability. As it is, a sufficiently persistent imagery permits some persons to arrive at solutions denied to those whose imagery is more diffuse. Persistence carried to extreme perseveration would prove to be a handicap, for it must fade with the arrival at a solution, thus freeing mental processes to proceed to other problems.

While the limits to the absorption of information by the human mind are not known, it is clear that neural habits will be established, utilizing familiar materials at levels of comprehension that have become easy. A man may read a dozen novels and not get a new idea. The question is, Had he polarized all this energy in the direction of hierarchical questions with which he is himself confronted, would there have been an upturn in the speed, number, and quality of his solutions, that is, an increase in his intelligence?

THORNDIKE'S VIEWS

As a grand schema of human abilities, Thorndike[1] presents the following:

> abstract intelligence or ability with ideas, as in language and mathematics, and much of science and affairs,
> mechanical intelligence, or ability to understand things, as in skilled trades and much of science,
> social intelligence, or ability to understand persons and other animals,
> leadership in its various forms,
> ability to cooperate in various ways and at various levels of ability,
> energy,
> persistence,
> ability to control oneself,
> ability to control others,
> persuasiveness,
> popularity,
> political ability,
> ability in law, the ministry, medicine, teaching, engineering, music, art, literature, acting, finance, buying, selling, management, agriculture, military work, scientific investigation, and other activities important for welfare,
> ability in courtship and marriage, as parent and guardian, as neighbor and citizen, as voter, critic, and supporter of representatives,
> ability to face the facts about the world and oneself and adapt one's own external behavior and inner flow of ideas to reality without evasions, or regressions to childish and perverse solutions. (pp. 57–58.)

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[1] Thorndike, E. L.: *Human Nature and the Social Order.* New York: The Macmillan Company, 1940. Pp. xx, 1019.

Of the abilities and traits listed above, it is clear that *abstract intelligence* is at the heart of the present definition of intelligence. *Mechanical intelligence* is included only in its abstracting phases, as in the reading of a blueprint or an insight into the relationships among symbols. *Social intelligence* is not so much excluded, as different. To get along with people one must be agreeable, at least superficially, in order not to be too disturbing to the personal adjustment of others. If the agreeableness penetrates into one's mental pattern, disturbing the objectivity and validity of intellectual insights, then social intelligence has interfered with abstract intelligence. The latter cannot swing around to data or concepts that are colored by social situations. Since Thorndike designates *social intelligence* as "the ability to understand persons and other animals," this would be an outcome and a goal of good behavior, and would itself be related to abstract intelligence. Persons are difficult to understand; understanding, when it is reached, implies a vast pyramid of generalizing and differentiating abilities.

Thorndike's *energy* and *persistence* are contained in the attribute of *concentration*. To give up while in possession of the mental tools possibly adequate for a task is to debase one's intelligence. To say that this is a necessary defect for persons of low energy or low goal-crystallization is to point again to the interrelatedness of the total organic structure. The situation is neatly summed up in the familiar teachers' lament: "Johnnie could solve this problem if he had a mind to."

Thorndike's trait *ability to control oneself* is contained in the attribute of social value, as are certain other traits listed above. In order to get away from straight measures of achievement in a hundred occupations or social situations, it is necessary to draw upon activities in a central pool of abilities to be designated *intelligent behavior*. The big strong boy must *learn* to throw the javelin. If the learning is so simple that it can be carried forth largely by imitation, with small recourse to reasoning, criticism, or judgment, then we have an achievement only slightly related to intelligence.

In any society traditional protections, military, religious, or civil, may be so strong, so ever-present, as to reduce to a minimum the intellectual demands upon any person. While we can postulate a growing circle of individual responsibility as we move from a strictly ordained, antlike society to a laissez-faire democracy, we shall still find large sectors of a man's time and responsibility removed from him by law, habit, and tradition. The best of democracies knows better than to keep its citizens mentally extended. Increasingly it offers him social bonds and ideologies fixed in work practices, schools, churches, protective societies, and legal statutes. A citizen can get along fairly well with very little thinking. He can hold a good job, achieve economic security, and live in a good neighborhood by simply following the lead of experts who are faithful to their special responsibilities. This does not mean that man's area of thinking has been reduced. Rather it has been changed. For example, parents need to do much good thinking in order to keep up with the best school practice. The teachers, nurses, and social workers of today are expected to excel their predecessors. Experts in all fields are more numerous.

ANIMAL INTELLIGENCE

It is commonly held that animals show intelligent behavior. Would they be excluded by the screening process implied in the attributes of intelligence, or perhaps be found on the lower rungs of the hierarchy? The whole question revolves about a choice of words. Obviously the present definition refers to *human* intelligence, just as we might speak of character, personality, wealth, or society in human terms without suggesting that lower forms of life are included in the conceptual patterns. Animals solve fairly difficult problems and the solution may hinge on perceived symbols, on likenesses, differences, and other relationships. They achieve a measure of insight, of generalization; they remember well. They lack speech, language, history, and a social guidance rooted in symbols. The child who pronounces his first word, meaningful beyond its onomatopoeic content, has forever outdistanced the other animals. To use the same word for animal and human abstracting ability does not lead to a convergence in meaning or problem-solving situation. The normal human child, for example, cannot undertake to run a maze as if he were a rat — he will reduce impressions to words while his "motor" choices are being made; he cannot be wordless. Analogously the rat gifted in smell is keen to use this sensory ability and if deprived of it, or placed in a milieu making no differential demands upon it, is no longer a true rat.

Intelligence, as here defined, may be said to take up about where mental behavior in animals below man leaves off. The chimpanzee's insightful problem-solving behavior as described by Koehler should be regarded as the forerunner of intelligence. For certain kinds of problems it may be more useful than verbal abstractions. In the same manner, well-trained sensory observation, in coordination with physical and motor aptitudes, carries the great load of animal learning and adjustment. The human child begins his activities in like fashion, but is soon distinguished by hand-cunning and a growing attention to sounds as meanings. When, in the Koehler experiments,[1] the chimpanzee's sticks were joined to form a longer stick in order to solve a problem, insight had intervened. But anything that can be solved with the hands alone and retained as hand memories with no other neural involvement than is essential to this process, need not be designated "intelligent behavior." The chimpanzee in solving this problem displays abilities that approach the requirements of the definition. His abstraction, while not expressed in words or symbols, is postulated from his ability to solve new problems with less motor exploration. He is like the child who learns before he speaks and later may learn fairly wide generalizations without the ability to describe them to others.

INERTIA

Men and animals stop learning by giving up, by going round and round, or by succeeding. May it not be that a man also stops learning by having the problems changed for him? He may be pulled out of a network of tensions and drives demanding learning and adjustment and placed in a quiet pool where nothing further is required. At this point a man lives in his past, applying to new problems the well-learned, well-oiled concepts of his earlier life. This is the solution reached by all old men; it is what is meant by becoming old. What is sooner or later an organic necessity may be regarded at any chronological age as a possibility. This mental inertia is not confined to the individual; it may characterize a society or an epoch.

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[1] Koehler, Wolfgang: *The Mentality of Apes.* New York: Harcourt, Brace and Company, 1925. Pp. viii, 342.

THE CONDITIONED REFLEX

Does the display of a conditioned reflex indicate intelligent activity? Hull believes that a conditioned reflex may be learned, that it is a law-of-effect phenomenon.[1] Conditioning stimuli save time; they permit reactions with smaller, earlier clews. They are informative and helpful, so long as the external conditions remain the same. But such reflexes are doubtful as expressions of intelligence-in-action because they are so close to tissue needs. They do not permit delay and choice in accordance with the demands of the problem. They are relatively automatic, uncontrollable, and remote from rational process.

Hunger is not intelligence. Intelligence as a concept has no meaning below adaptive learning that favors the animal confronted with a new, unresolved situation. The tiny fish, swimming in his salt sea "soup," absorbs nourishment without benefit of adaptive behavior until disturbed. If the change is in the chemical nature of the food, the organism may survive without solving other than tissue problems. The borderline cases appear when fish-learning or fish-migration is demanded. If the fish move away *en masse*, following sensory cues, insight is a doubtful postulate. An intelligent act is always the act of an individual organism, even though it be generally shared. Universality of solution springs from a low saturation with the attribute of difficulty. To get to the first stages of pre-intelligence, every organism has to be able to perform the task, on its own, even though the utilization of group contacts and observations contributes to its mastery.

Thus, among men, a crowd sometimes acts as if every member of it were thinking, when nothing of the sort is true. If fifty men pull at a rope, thus arriving at an intelligent solution of a problem, only one may be entitled to high mental credit. Intelligence may be displayed over the whole gamut from genius to idiocy: (1) The genius-rating mind arrived at a remarkable solution that made heavy demands on the attributes; it called for rope pulling. (2) Some bright and average men then "saw" that a solution was thus offered. (3) Some dull men "saw" little (or nothing), but they pulled. (4) Some low-grade intellects, to whom problem and solution were utterly incomprehensible, nevertheless accepted, animal-like, the task of rope pulling.

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[1] Hull, Clark L.: Mind, Mechanism, and Adaptive Behavior. *Psychological Review*, 1937, 44, 1-32.

POTENTIAL INTELLIGENCE

The rough and ready doer of every task as it comes is by this alone no highly intelligent human being, nor is a well-read library worm the most intellectual of human beings. He must be tested in a tougher world. The content of any genuine intelligence test will screen them both out. Teachers generally have been sensitive to the low intellectual rating of the manual laborer, the craftsman, and the doer of tasks, and have gone too far. With respect to the bookworm, the knower-of-facts, the reciter-of-ideas, they have been too lenient. They have kept him long and mistakenly within high-ranking intellectual circles. The man of good health, good deeds, and good emotions may rank intellectually low, while in a culture viewed as a whole, he becomes important. The honest worker, good companion, and social contributor has the heart and enough of the intellect. It is the pseudo intellect, frequently lacking in these solid virtues, who regards himself as at least higher on the intellectual side. A lack of skill in manual work, or of sympathy for it, tells nothing at all about verbal or scholastic aptitudes.

Any definition of intelligence must allow for a range from the least intelligent idiot to the most intelligent genius. All human beings must be considered as showing a modicum of intelligent behavior, if they live and interact at all. This beginning may be considered as just above the zero point. From that point upward, differences may be considered to be in degree so long as we recognize a process of complex development. Development, by definition, implies more than a monotonous curve applied to ongoing skills or abilities. It leaves room logically and practically for the emergence of activities different in meaningfulness and cultural level from what has gone before. Potential intelligence may be regarded as the ability that can be developed or salvaged. In the young child potentiality exceeds delivered mental power, since the expectation is one of growth. In the adult mind, there is less likelihood of a growth continuum. Potentiality is a function of the accuracy of our measurements. What we thought was an adult mind may still have growth potentials. We may take the theoretical position that from any point on a plateau of adult ability there can be an upward movement. There could be an upsurge in mental ability, let us say between the ages of thirty and forty. Such upturn could result from a stronger factor of concentration and new urge toward abstraction. Similarly, the general downward trend of ability with advancing age need not be postulated as a smooth decline, although no available mental test will permit refined observations.

Man has sprung from apelike creatures, but he is no longer an ape nor can he be reduced to one. An original idea is not an aggregation of nonoriginal ideas, however difficult and complex they may be. This does not imply any break in organic evolution. Without the larynx or its equivalent there will be no speech, but speech is neither larynx nor brain-pattern, but a cultural phenomenon. In like manner, intelligence is not and never can be an organ in the body. It is not the brain, the nerves, the glands, or the musculature, nor all of them taken together. If always we think of intelligence as *behavior designated intelligent,* we shall avoid confusion. Unfortunately the language demands substantives where there is no substance.

All intelligent activity draws heavily upon social inheritance. The child and the man work with symbols and relationships, with pools of knowledge that are handed down. What is here called intelligent behavior, as mediated through a specific organism, would be strange indeed in the absence of a cultural heritage. On the other hand, there is no theoretical bar to a deterioration in nervous structure that would make the world that has thus far been created incomprehensible to the average man. This could happen through widespread genetic misfortune or as an outcome of retarding forces playing upon the child and poisoning society as a whole. The first half of the twentieth century will some day be marked as having displayed a particularly dangerous convergence of the dysgenic forces of unfavorable birth statistics and environmental hazard.

CHAPTER II

THE PHYSIOLOGICAL BASIS

The dependence of behavior upon physical structure makes it necessary to discuss the physiological basis for intelligence. The mental testers from Binet onward have not been concerned with inner organic developments. One of Binet's contributions was to get away from the idea that anything in detailed nerve connections, in sensations, perceptions, or muscular movements, could be utilized as a means of measuring the relative mental status of children. The futility of direct sensory approaches to the measurement of intelligence was confirmed by the early attempts of the Wundtian psychologists.

Intelligence testing proceeds without direct recourse to what is going on within the skull. As in the days of Binet, testing poses questions and problems that enter a sensory channel of the child, essentially the auditory and visual modalities. The child is asked to respond in gestures and motor manipulations and, above all, in words. Perhaps an analogy to the automobile would be helpful. In one period of salesmanship dealers stressed the "innards" of cars. We were told about the N-bearing crankshaft, the special rear axle, or the valve-in-head. Mechanical secrets were everywhere displayed with reference to favorable discriminations for a given car. There is much less of that today, for owners and potential owners concentrate on performance. Many persons never look under the hood. What they want is a handsome, speedy car that runs smoothly and costs little. These matters can be settled without direct reference to the machinery. So far as the buyer is concerned, the less machinery the better, his response being chiefly to external features. He can judge smoothness, speed, line, and color. His gas station will supply him with a measure of fuel economy. Objective tests could be "standardized" for these qualities; in consumers' organizations there has been some attempt to do this.

Who, then, needs to be concerned with what goes on under the hood; who needs to worry about what is in the skull? The answer is somewhat the same in both instances. The car manufacturer will need to know the strength of materials, the quality of fuel, the relationship of engine parts and so forth, if he is to turn out a mechanism that satisfies both the technical designer and the pragmatic consumer. Anybody concerned with evolution, individual development, or cause and effect relationships, all involving complexities of heredity and environment, will need to know something about the organic mechanism involved — if the concept of intelligence is to grow in meaningfulness. There is, of course, a patent divergence as between car and human body. The car does not build itself or run itself or feed itself; it does not develop or evolve into something different. All its changes are in the nature of deterioration. It has no growth pattern, no irritability, no self-perpetuation. It is part of an evolutionary line, but the units in this continuum are not in a series of car mechanisms, but in a succession of human brains working on the car problem. Not so the human organism: it grows, changes, responds, reproduces itself. It is at once a determiner and a product of environmental forces. It makes changes in its environment and changes itself in the process; the changed environment has a differential effect upon the organism itself. Thus man can refine food until he is starved by it. When sufficiently impoverished, he may be forced to give up the luxury of further mechanical depletion, thus throwing the organism back upon simpler ways and simpler foods — back in Samsonlike fashion to the strength that was his in the beginning.

In short, an answer to the question, *Why study physiological and neurological data?* is self-contained in these subquestions:

(1) What is the progress of mental development up through childhood?

(2) What is the relation between organic tissue, as in the brain, and intelligence?

(3) What are the structural counterparts of theories of learning and intelligence; are current theories consistent with available neurological data?

(4) What are the respective contributions of heredity and environment to intelligence, and what interrelations are involved?

(5) What are the limits of intelligence in any species or individual, as determined by organic structure; to what extent are such structures gene-controlled?

(6) What are the limits of intelligence as determined by cultural opportunities?

CEREBRAL ACTION

All biological authorities agree that the chief factor which differentiates man from other species is the intricacy of his nervous system, particularly the cerebral cortex. The development and maintenance of this marvelous structure has made man what he is. Sherrington [1] observes that, among animals, the nervous system is the ultimate in plasticity. Man's place at the top of the evolutionary ladder was reached in terms of his extraordinary cerebral development.

Since the organism as a whole is a product of its environment, not understandable even in casual terms without such reference, the brain and nervous system can only be understood, in an evolutionary or present sense, in relation to the whole body. As Sherrington [2] says, the necessity for a brain lies in the management of muscles:

> . . . the brain is a form at work within another form, the animal, itself shaped largely to suit mechanical powers. . . . Inside the animal's form sits the brain, its work broadly to increase the animal's grip on the world about it, and hardly less the grip of the external world upon the animal. Grown up with the animal it fits the motor mechanism of the animal much as a key fits its lock . . . nerve and brain are but a skilfully laid train of powder between the muscles it fires and the restless world outside which fires it. The question who turns the key, to use that simile, is soon answered; the outside world. (pp. 5-7.)

He points out that brain pathways lead directly or indirectly to muscle, as if action were to the mechanism its all-in-all. Yet to refrain from an act is a type of action, a type for which the nervous system is equally well constructed.

If we are to follow the well-known studies of Sherrington, Adrian, and others, we must accept at present the idea that a series of disturbances showing an electrical sign moves along nerve fiber, an action capable of much variation in the number of signals sent off, even though these signals themselves do not vary in size or quality. Such signal trains moving over the nerve-net may start either from the outside, as in reflex actions, or from internal stimulation.

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[1] Sherrington, Charles S.: *The Integrative Action of the Nervous System.* New Haven, Conn.: Yale University Press, 1926. Pp. xvi, 411.

[2] Sherrington, Sir Charles: *The Brain and Its Mechanism.* Cambridge, England: The University Press, 1933. Pp. 35.

The extreme profusion and intricacy of these processes in the nervous system invalidate at once all theoretical formulations of response, learning, or intelligence that depend upon simple one-to-one relationships along isolated channels — no simple reflex or bond theory can possibly hold. The difficulty is not in rejecting such oversimplified constructs, but in explaining, through the utilization of verbal concepts, how electrophysical operations are translated into mental events. Within the nervous structure, the junction points in the network exert control. They may set up an inhibition, this action involving work. Whether yielding inhibition or excitation, the signal appears to be the same as it moves along. A key to the organic structure underlying external acts designated "intelligent" will some day be found in a complete understanding of the mechanism of the synapse. This is the choice-point in the system, the choices of which are up-to-the-second affairs: a functional unit performs up to its present limit, each impulse taking its place in an ungapped series of electrochemical events.

It is not for nothing that the animal's head is in front. It reports what may happen to him. We might go further and say that with head horizontal, nose to the ground, and eyes on top, it becomes difficult to allow mechanically for the development of his frontal lobes. The animal moving along on four feet, especially if low to the ground, could be seriously handicapped in vision. Man's erect posture permitted the development of these lobes, and his greatest projective sense organ is optical, not olfactory. In common with some other animals whose evolutionary existence he shared almost point to point up to a few hundred thousand years ago, man, prior to speech and to work with tools, had developed marvelously skillful adaptations through the simpler sets of reflexes and reaction pathways.

To Sherrington, the new cerebrum is essentially "a gigantic combining mechanism," differing from other networks chiefly in intricacy: "Before it, truly, there were educable systems in the animal world, but this is so educable as to be practically a new thing in the world."

Adrian[1] holds that electrical changes occur when a nerve is in action and that variations in potential give a measure of nerve impulse:

> . . . it follows that the potential change is an essential link in the transmission of the impulse: if it is found not to vary with the stimulus there can be no possible variation in the impulse: the duration of the period of surface breakdown must coincide with that of the potential change, and the surface breakdown is, in fact, the impulse, the disturbance which propagates itself down the nerve fibre. (p. 20.)

He postulates that the stimulus from the sense organ may be like the surface depolarization in the activated nerve fiber, but more persistent. Psychological intensity is a function of the frequency of the impulses. With regard to pain, Adrian inclines to the view that the slower and smaller nerve fibers are usually responsible. He believes that all nerve cells are fundamentally alike.

APHASIA

In view of the close relationship between intelligence and language, we cannot fail to be impressed by a possible carry-over of Head's findings on aphasia[2] to the problem of developing intelligence. To quote Head:

> The processes which underlie an act of speech run through the nervous system like a prairie fire from bush to bush; remove all inflammable material at any one point and the fire stops. So, when a break occurs in the functional chain, orderly speech becomes impossible, because the basic physiological processes which subserve it have been disturbed. The site of such a breach of continuity is not a "centre for speech," but solely a place where it can be interrupted or changed. (p. 474.)

A source of strength in Head's work is the richness of his clinical experience and a steady approach to the problems of speech as psychological in nature. He avoids an atomism of structure or behavior; he recognizes that there is no clear link between anatomy and clinical observation. He admits that "few have attempted to consider the steps by which a structural change evokes a physiological disorder which in turn is manifested as some defect of a specific psychical process."

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[1] Adrian, E. D.: *The Mechanism of Nervous Action: Electrical Studies of the Neurone.* Philadelphia, Pa.: University of Pennsylvania Press, 1932. Pp. x, 103.

[2] Head, Henry: *Aphasia and Kindred Disorders of Speech.* Vol. I. New York: The Macmillan Company, 1926. Pp. xiv, 549.

To Head, centers in the cortex are not particular masses of cells or tissues; they are nodal points that permit changes and integrations. Disturbances in centers interfere with an ongoing process, even though the centers have not themselves originated or determined the process. Their blocking out calls for a redirection of control and consequently a reorganizing of the nervous pattern viewed as a whole. Corticalization does not generate new energy but does permit new freedoms of choice, that is to say, a higher level of intellectual behavior.

Any attempt to find out what happens to language or other abstract responses in terms of localized cerebral mechanism is like trying to discover just where a war began: in neither case will a geographical survey suffice, even though what has happened in a given locus may have discernible effects upon the events that follow. Once we have learned to think with words or numerical symbols, we can study the aphasic blocks to thinking that reflect this habitual dependence. The words are helpful, revealing, and enriching; they have indeed become essential to clear thinking. Given a disturbance to a center concerned with the more involved relationships, we shall find no good substitute for words, but only a mental clumsiness that will show up in any test or definition as a defect. Such defects, while different from juvenile mental patterns well integrated at a lower level, are just as real.

There is an immediacy to all mental measurement. Given adequate tests, we should be able to tell on a given day the status of intelligence for any person. Neither the far-removed nor the recent past of the individual, whether viewed in terms of inferred postoperational neurology or of clinical symptom, adds anything to the validity of the test for *intelligence*. However a case history will be helpful in prognosticating behavior. A full knowledge of the mental test results and the medical record of a congenital imbecile may yield a less favorable prognosis than that made in relation to a similar test performance on the part of an adult who is aphasic, amnesic, or convalescent from a cerebral lobectomy. In intelligence testing no attention is paid to the physical or physiological condition, except to secure an optimum rapport. The aphasic, for example, will be neither pampered nor penalized for his condition — he will simply be measured.

It appears from Head's case reports that some of the functions that become automatic remain important to the integrity of speech reactions and to intelligent behavior. There is in habitual or automatic functioning a dynamic reservoir of data, relations, and systems which, as learned behavior, provide a base for the further solution of problems. One solution of a problem that characterizes a habituated and cultured person is not to see it as a "problem," but to know the answer from the start. Information tests and standard questions in intelligence tests are rendered easy for intact mechanisms of rich, past experience. The demand for integration comes with truly new materials, problems, relations, and systems; in most testing it is meager. With the destruction of higher cortical tissue there would not be, according to Head, a necessarily permanent loss of old skills and powers. They would tend to be restored. But the acquisition of new learning or, in the child, a continuation of the line of increasingly abstract behavior, would by such destruction undergo deceleration, regression, or stoppage.

There is no doubt about the loss in mental ability displayed by aphasics, if we accept the definition of intelligence proposed in this volume. This viewpoint has been anticipated by Piéron[1] who pointed out that, in terms of Binet-type intelligence, the suppression of verbal thought is a defect. In this sense, Piéron regards the uneducated person in modern society as mentally defective.

Since aphasic disturbance is considered conceptual and symbolic in nature, it comes directly to the central concept in intelligence. To say that intelligence is concerned with symbolic process, is not to say that it can exist in an organic vacuum. It requires a nervous structure permitting such functioning in the same sense that it needs the necessary organs of heart, lungs, and stomach. But we do have a division of labor. If we are to use the term *intelligence* at all, it must be restricted and differentiated. The physician knows that the heart cannot work without the brain, but he may become nevertheless a heart specialist. It is feasible to examine a locus within a structural complexity, to study a point within an area or a field of force.

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[1] Piéron, Henri: *Thought and the Brain.* New York: Harcourt, Brace and Company, 1927. Pp. xvi, 262.

THE MIND-BODY PROBLEM

There is no such thing as "having" intelligence while not having it available. Mental capacity is not a system of cold storage. If a car is broken in some essential part or lacks fuel, it will not run. A subsequent repair cannot disturb the validity of the earlier observation: "running ability nil." The expert mechanic can *predict* whether or not a car in a certain condition will run and with what maximum speed; a high-school boy can state with confidence that his "jalopie" will not break any records for speed or reliability. So a neurologist can make predictions of comparative abstract behavior among human beings. But the neurologist, like the layman, can do this only at the extremes of impoverishment, deformity, or deterioration. The whole village knows the idiot, but academies of science have welcomed men whose schemes for differentiating IQ 70 from IQ 170 were quite worthless.

Perhaps the chief difficulty in any discussion of the nature of intelligence lies in the deeply rooted human tendency to get entangled in the classic mind-body argument. Children, as they grow in language ability, wrestle with newly perceived problems of structure and function, of object and concept, of a three-dimensional world conceived in a time series and mastered through attention to complex sounds and marks on paper. Permeating the whole structure is a curious system of values that changes from one situation to another and is not the same for every person.

Of special interest, therefore, is Carmichael's recent compact account [1] of intelligence in its physiological relationships.

> Intelligent acts, at least in man, have always been considered as related to the individual's so-called *mental life* as well as to the activities of his *body*. . . . The task of investigating this relationship is the aim of a scientific physiological psychology. If human intelligence can operate even occasionally without being related to the activity of the living body, the whole study of the nervous system,

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[1] Carmichael, Leonard: The Physiological Correlates of Intelligence. Thirty-ninth Yearbook of the National Society for the Study of Education. *Intelligence: Its Nature and Nurture.* Part I.: *Comparative and Critical Exposition.* Bloomington, Ill.: Public School Publishing Company, 1940. Pp. xviii, 471. (pp. 93-155.)

> for example, in relation to behavior becomes speculation, not science. The undoubted facts disclosed by the brain surgeon, however, to take but one of the many possible lines of evidence, will keep most individuals from any serious consideration of such an essentially mystical theory of intelligence. (p. 94.)

Let us assume that a child has just learned that the French word for black is *noir*. We may assume that an organic change has taken place. His new knowledge has reference to something in the nervous system, the latter behaving differently because of it, and "causing," that is, *continuing into* observable differences in external behavior. This view does not imply vitalism or mysticism, nor is it the maligned psychophysical parallelism; it is rather a question of physical extension. The *words* do not exist below speech (or inner speech), but we postulate the energy patterns that can be evoked and made meaningful to the sense organs of another person, as well as to the actor himself. That this phenomenon involves some kind of trace or signaling system is axiomatic. When stated in general terms, this does not require proof, but only the acceptance of a real in standard scientific discourse. This can be shown by positing its opposite, namely that since neurology has not discovered the location, the character, or even the existence of the difference (except by psychological means), there is, therefore, no organic difference as between ignorance of *noir* and knowledge of *noir*. Who can believe this? Is such vitalistic thinking any longer permissible? We must avoid the horns of this dilemma, the one representing plausible but imaginary neural mechanisms that have been spun out more by psychologists than by neurologists, and the other a denial of any organic trace or structure. The one has led us to be skeptical about all cerebral concomitants of learning and behavior; the other, in its zeal to establish a science of psychology, would make cabbage heads out of the skulls of observers and of the Adrians, Penfields, and Sherringtons!

Most persons are agreed on the essential need for an operational viewpoint. Some questions, even when plausibly concocted, have no real meaning. Any good question must admit of potential solution within the human means available or conceivable. Speculation that does not adhere to the rules is futile, and often dangerous, as in the tendency to rely upon astrology in the prediction or interpretation of human events. Any fact existing anywhere in the universe, if it is to be causal with respect to other facts, must be in some kind of observable relationship. Sunspots may affect human behavior because of a relationship between weather or radio and the condition of the sun's surface. If this can be subjected to analysis, we have a true problem. Similarly the future cannot affect the past except as human beings attempt to predict it, adjusting their present actions in terms of their own prognosis.

Psychology rightly develops concepts, issues, and relationships in its own terms and with its own measures of reliability and validity. The field peculiar to psychology is not chiefly concerned with anatomical or physiological conditions or with general internal environment. It is in essence a person-to-person and a person-to-object relationship; it is social. Analogously physiology is not essentially physics or chemistry; nor physics, mathematics. The hierarchical considerations involved have been well understood since the days of Auguste Comte; they need not be reviewed here. No physicist denies the value of mathematics to his subject matter, and no biologist or neurologist feels indifferent toward molecular behavior. Within certain overlapping fringes, progress at one level is contingent upon progress at another. Nor is such contingency always from the top down: the physiologist, for example, may set problems for the psychologist, as he did when the latter assumed that one neuron might connect uniquely with another. Likewise the psychologist may set problems for the neurologist, asking him what light could be thrown upon various aspects of abnormal behavior. We need not demand a point-to-point relationship or a meaningful temporal coincidence. There is no little man in the egg, but without the egg there would be no man; there is no little word in the human cortex, but without the cortex, words are nonexistent.

The problem of specificity in brain functions remains, but the idea of exact locations in the brain has been given up. It is somewhat like asking, Where is "carness" in a car? Without a spark plug, the running ability of the car will disappear. Similarly, a part or organ that is *necessary* for brain functioning and for intelligent behavior, for example, the heart, is indeed not *sufficient.* To some degree this applies to any part of the brain itself. Any organic structure determining the attributes of intelligence *is* a part of its substratum. The underlying structure of intelligent behavior is the body taken as a whole, with contributions from its various parts and functions that run the gamut from the almost inconsequential to the immediate and crucial.

Not structuralized, but obviously essential (as fuel to a motor) is the ever-present bodily intake from environment, not only in chemical exchange, but in the acceptance as goals of problem situations that mobilize bodily resources. Man, like all other animals, is a chunk of earth materials with no existence separate from his parent substance — truly a complicated form permitting much freedom of locomotion and characterized, over the last few thousand years, by an extraordinary dependence upon an artificial environment which slight anatomical variations have made possible.

It is feasible within the brain of man to ascend an evolutionary ladder. The olfactory cortex, for example, is highly developed in many animals, and man has no advantage here, but a relative deficiency. Man's new brain, his cerebral cortex, is in lower animal forms rudimentary. It may take over some of the lower functions. At least, some of the lower functions no longer are carried on and developed as they would be if the cerebral cortex were not paramount. The higher centers devoted to hearing and seeing have made man adaptable to his environment, permitting speech and a written language, along with a coordination of hand and eye that, in terms of motor skills alone, is something unique among animals. In a complex nervous structure we do not find equal potentiality, strict localization, or inevitable pathways, but an infinite variety of contacts, connections, and structures.

Man's mental ability (that is, his demonstrated power) is incomparably greater than that of any other animal, but this power may be generated by a nervous system only slightly above the chimpanzee in structure. There is a general acceptance of Donaldson's early view that no new brain cells are produced as the child matures. But the brain cells do change and grow. The question is, What determines this development? Since mental ability is correlated with growth in the nervous system, a unit or period of behavior may affect subsequent *nervous growth* as well as subsequent *behavior*. Anything learned affects nervous tissue. Reciprocally the process of learning is an outcome of conditions in the nervous system and it is, moreover, one of the conditions of further growth. However, many changes in brain size and complexity related to development in sensory and motor processes may not be based upon "intellectual" activity, but on any activity given to a normally growing body.

Are some parts of the cortex developed in relation to differentials in experience or motivation? Are participation and training factors in intellectual growth? In mental testing a strong behavioral pattern is vocabulary. Is there a lump of vocabulary whose limits are set, such that Twin A starting at the age of five would catch up with Twin B starting at the age of one? This means that Twin B would have to slow up or stop learning new words; the question is, Why should he? Obviously, a deprived child can never reach or surpass his biological equal, unless the latter (*a*) retards or stops his learning, or (*b*) exhausts the limits of the problems or areas designated "intelligent." Since intelligence rests upon such inexhaustible attributes as *difficulty* and *complexity*, alternate (*b*) can be ruled out on theoretical grounds. We must ask, When does a person stop *climbing*, and when does he stop *gathering?* Senility is a failure to take on anything new; the gathering is of the leaves of the past.

Carmichael says, "Specific function plays a negligible part in the growth and differentiation of the cerebral hemispheres." (p. 126.) He also says, "Growth in the nervous system is related to the stimulation of non-active cells by active ones." (p. 126.) Perhaps the higher mentality seeks its stimuli and is depressed only if the impoverishment is substantial. Can we get too far ahead with "exercise" in the sense of forcing plants, thus securing not an optimum growth but a maximum growth — for the time being? I can find no clear evidence for this, except that organisms may show abnormal behavior when the choices demanded are extremely difficult, confusing, or painful. The choices themselves may be primarily physical or motor. The sound limits of motivation are exceeded when the child declines in the attributes of intelligence or develops symptoms of pathological behavior. In this connection Carmichael holds that

> the specific educational regimen provided for each child is of the greatest importance in relation to the intelligence he will demonstrate in any specific social order as measured by tests devised for

use in a given society; that is, there is no physiological or psychological reason why educational procedures may not so modify each individual organism that he will be more effective in solving certain types of problems than he would be without the specific education in question.

As we turn to a brief account of changes in brain tissue, may it not be said that the mind-body problem, like so many others, far from being "solved," has been recast, with special reference to the connotation of *mind?*

BRAIN LESIONS

The main purpose of this discussion is to examine neurology in relation to intelligence and to show the extraordinary complexity of the problem. For example, if we were to postulate hereditary strains that determine the final level of adult intelligence, it becomes important to know what cells, tissues, or segments are under consideration; in short, to establish a genetics of nervous structure. Is there a gene-controlled tendency for a structural weakness leading to lesions in frontal or central areas of the cortex; is there a gene-controlled tendency for these areas to be slow-growing or unresponsive?

Recent explorations utilizing electroencephalograms have opened up the possibility of genetic controls in terms of physiological and neurological phenomena. Thus Lennox, Gibbs, and Gibbs[1] have presented evidence on the heritability of epilepsy and of electrical activity in the cortex which may indicate "potential" epilepsy. There were more abnormal encephalograms among the relatives of epileptics than chance would allow. What is needed, however, is more knowledge of the etiology of this disease in order to avoid a possible repetition of the nineteenth-century error that led to the "practical certainty" that tuberculosis, running so strongly in families, was a beautiful example of inheritance.

At one extreme will be found medical workers like Alford and Dandy who claim that large amounts of brain tissue can be removed from areas previously considered crucial to functional integrity, without the corresponding deep-seated changes that have been predicted. Alford [1] speaks of

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[1] Lennox, W. G., Gibbs, E. L., and Gibbs, F. A.: Inheritance of Cerebral Dysrhythmia and Epilepsy. *Archives of Neurology and Psychiatry,* Chicago, 1940, 44, 1155–1183.

> . . . the too great reliance which scientists have placed on the cortex in connection with mental processes and related functions. Dandy and, no doubt, others began to recognize the extent of this error when large excisions of brain tissue did not result in a comparable disturbance of these functions. Now the basal structures, particularly those of the left side, take on added significance and many readjustments in accepted conceptions become necessary. That the remainder of the brain may complement, complete and intensify does not alter the fundamental conclusion. . . . Correlated clinical and pathological studies of seven cases, among a number of corroborative points brought out, serve to localize still more exactly the structures from which intellectual defect is produced by injury, both negative and positive evidence indicating that these occupy a relatively small area situated posteriorly in the basal region of the brain. The implications of this conclusion seem to be extraordinarily far-reaching. (pp. 631–632.)

Far-reaching indeed is the idea that so much of our brain tissue is superfluous! Before accepting these interpretations we may list a few questions pertinent to the psychological issues. Wherever the physician uses mental tests it is important to know what kind of mental tests or tasks are presented. Could it be that most intellectual processes have their organic seat in the "speech area" of the cortex? How large is the speech area? How complicated? How is it related to frontal lobe reactions in the intact brain? These questions concern the common mental growth of the child, as well as deterioration and abnormality. What are the organic accompaniments, prerequisites, and outcomes of "normal" mental growth? For example, how does the brain differ at the age of sixteen from the age of six?

The work of Goldstein and others (to be mentioned presently) indicates the difficulties in ascribing a particular mental function to a particular brain region. There are divergences among expert surgeons as to the actual nature and extent of the operations performed, and in the relation of such tissue removal to changed mental behavior.

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[1] Alford, Leland B.: Defects of Intelligence from Focal Lesions within the Central Part of the Left Cerebral Hemisphere. *American Journal of Psychiatry*, 1937, 94, 615–638.

Sources of Confusion

The points that follow may be helpful in explaining such discrepancies. (Perhaps the wonder is that there is any residual of validated phenomena.)

(1) What is the amount of destruction? This is not easily determined in the living human organism, there having been cases in which pus was mistaken for brain tissue.[1] Moreover, the idea that an operation destroys tissue only at its site is difficult to establish. A further complication lies in the possibility that the diseased tissue before removal is acting as a mechanical or chemical deterrent to proper brain activity. That is, there may be pressure or a contamination from diseased tissues.

(2) The subjects reported in the literature are likely to be older children or adults. Such operations throw a poor light on what would happen to the subsequent mental development of a child who had lost, let us say, large amounts of frontal tissue in the preschool years. Also there seem to be lacking good case studies of the type of deterioration that takes place in ordinary old age and senescence. What is needed is an account of changes in nerve cells with concomitant changes in mental achievement or behavior.

(3) The brightness of the subjects may be of importance. Since children arrive variously at their points of deceleration and cessation of mental growth (as determined by external tests), the per cent of final growth attained at any given period is a necessary parameter. For example, what about the reality of the substitution of one cortical area for another; can certain association areas take over some of the functions of the frontal lobes? If so, at what ages, under what conditions, to what degree, and for what types of mental behavior?

The mental tests reported for most patients in the operating room are unsuitable. Frequently they are not well described. A subtle operative technique on the part of a distinguished surgeon may be coupled with the crudest kind of clinical observation of adult mental behavior. This behavior is poorly measured by tests, particularly under conditions of convalescence from a major operation. In summing up such data, it is not enough to ask what is the effect upon general mental level, if that can be ascertained; we ask also what kind of behavior is affected, for example, as between concrete and abstract. That there are agreements and disagreements will appear shortly. The final questions for our purposes cover the implications of surgical operations ("insults" to nervous tissue) for the meaning of intelligence and its development within the individual.

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[1] I had the opportunity of examining the brain of a war case which I had studied, where there was an operation for a deep abscess in the frontal region. The surgeon, after cleaning out the abscess, had found a cavity the size of a fist. Not only were there psychical disturbances which might have passed unnoticed in rapid examination, but the loss of cerebral substance was in reality insignificant. After cleaning out the pus which had formed the cavity, not so much by destruction as by pushing matter aside, the tissues had taken their place again and there was very little injury apart from a small nuclear scar. But the surgeon had honestly supposed that a great part of the hemisphere had been destroyed. (p. 41.) (From Piéron, Henri: *Thought and the Brain.* New York: Harcourt, Brace and Company, 1927. Pp. xvi, 262.)

The Brain as Counterpart

Correlations are rare in tissue-behavior pairings, and when found are thus far rudimentary. We look within the skull only to find a complexity that almost defies measurement or analysis; it is indeed the counterpart of man's outer life in his relation to the entire environment. All tools from the simple hoe to the atom smasher are extensions of this brain mass. They are as much a part of man as his clothing or his language. They are scarcely less a part of him than tooth and nail and hair — they are simply more deciduous. If we were to portray man to some other creature who could learn and believe, it would not suffice to present him nakedly in all his weakness. Nobody could understand him through weights and measures, or by testing his sensory and motor capacities. Somewhere in the line of comprehension there would need to be a tapping of his rich storehouse of nerve cells and nerve patterns. Even this would be futile without scientific and cultural extrapolations of his person. We should need the liberty of a child's comic strip or a Disney cartoon to attach to man all those appendages upon which further technical achievements depend. He would be a man whose eyes were at once microscope and telescope, whose ears responded to vibrations around the world, and whose power was that of a million harnessed giants. About this there is no unreality except in forming a unitary visual representation of such a phenomenal creature. Man is himself and all the power that he can lay hand and brain to.

Since man in a hundred generations cannot have done much about his cerebral lobes, either in quantity or quality, the advance must have come about through the utilization of potentialities already there. The classic Greek was great as an artist, a fighter, and a philosopher. He could have been great in science and technology had his mentality been turned in that direction. That the scientist personifies the right direction cannot as yet be completely established: the sweetness of the fruits of great technical progress can be judged only through applying to the problem a genuine social science in which human evaluations are paramount.

The Frontal Lobes

Goldstein[1] in his studies of the frontal lobes points to certain factors that have contributed to a divergence of interpretation with respect to the changes in mental behavior following operations:

(1) Inadequate attention to site, extent, and nature of the lesion.

(2) Whether the lesion is in the right or the left half of the brain, or in both. (He believes that mental disturbances will follow only lesions in the prefrontal regions of both hemispheres, or a large lesion in one hemisphere, particularly the left.)

(3) The actual amount of tissue damage in different kinds of lesions and its extension beyond the particular site.

(4) Inadequate preparation for recording and analyzing the different psychological changes involved.

From personal histories, Goldstein comes to the conclusion that even in cases where the first evidence of a defect is in a slowness of response, the disability lies in the transfer of a solution from one situation to another, that is, in abstraction. He says:

> The disturbance of the patient, it is apparent, lies in the circumstance that he is unable to assume an attitude towards the abstract, but is able to act in a concrete way. . . . Failure is more certain and pronounced if, after he has begun to act, the situation is modified in such a way as to require readjustment on his part. . . . Finally, we have yet to deal with two symptoms very frequent in frontal lobe lesions, viz, alteration of memory and of attention, which are often considered the basic disturbances of these lesions. (pp. 30, 33–34, 36.)

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[1] Goldstein, Kurt: The Significance of the Frontal Lobes for Mental Performances. *Journal of Neurology and Psychopathology*, 1936–1937, 17, 27–40.

There is less disturbance of memory for old impressions than for new and the use of memorized materials is in relation to concrete situations. Similarly, new learning will be concrete in type and not transferable by way of some generalized or systematic procedure. The patient on the whole has lost abstracting ability, originality, and an easy adaptation to novel situations. Looking at this from the standpoint of a hierarchical arrangement of mental test items, we are justified in saying that he has lost the very essence of intelligence. Such patients fail completely to produce the higher reasoning that characterizes modern culture; they are unable to retain a partnership with its growing edge.

From Penfield and Evans[1] we get, so far as intelligence is concerned, a comparable picture. Thus in a certain patient, "The loss of the right frontal lobe had resulted in an important defect. The defect produced was a lack of capacity for planned administration. Perhaps the element which made such administration almost impossible was the loss of power of initiative." (p. 131.) In another adult case most of the mental behavior was good, except that there was a loss in the ability to add mentally and a progressive deterioration in Binet mental age, accompanied by a loss of initiative. A third younger case (age nineteen) involving excision only in the right frontal lobe did not show immediate psychological defects.

Brickner's classic case[2] involved the removal of a large portion of both frontal lobes (116 grams of brain tissue) from a patient forty-one years of age. From the full account of this case we observe restriction and retardation in the processes of mental behavior — "a definite limitation in the degree of complexity with which the processes can be associated." (p. 39.) Here again the loss is in the ability to make abstractions, to synthesize, to put ideas and experiences into a meaningful whole in the service of further decisions or actions. There are also emotional and personal involvements which, in the aggregate, would appear to change completely the behavior, adjustment, and effectiveness of this successful business man. Mental tests showed deterioration from the levels presumably necessary for his previous success. In view of the new symptoms elaborated, we may question Brickner's interpretation of the mildness of the changes that have been made. He says:

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[1] Penfield, Wilder, and Evans, Joseph: The Frontal Lobe in Man: A Clinical Study of Maximum Removals. *Brain*, 1935, 58, 115–133.

[2] Brickner, Richard M.: *The Intellectual Functions of the Frontal Lobes: A Study Based upon Observation of a Man after Partial Bilateral Frontal Lobectomy.* New York: The Macmillan Company, 1936. Pp. xv, 354.

> Thus there are produced disturbances depending upon the separate activation of relatively simple units which formerly were synthesized, and also disturbances in complex derivative faculties whose existence depends upon such synthesis. Hence, the changes are fundamentally quantitative, and not qualitative in character. . . . There is no real evidence, either in A's case or elsewhere, to show that the frontal lobes play a fundamental role in intellectual function which is more special than that of other parts of the cortex except, perhaps, in a quantitative sense. . . . The frontal cortex may be thought of as tissue that enriches the intellect immensely, by virtue of multiplication of the associative possibilities. The frontal lobes would then be, from a biological standpoint, luxuries; intellectual activity of a fairly high order can proceed without them. (pp. 289, 302–303.)

The question is, What is meant by the term *fairly high order?* This patient, like other adult patients, had reached his mental level presumably while in possession of the facilities of his frontal lobes. Their final impairment does not tell us what would have happened had this loss occurred, let us say, in early childhood. Without the synthesizing that the frontal lobes permits there might have been a lower order of mental development. Moreover the distinction between *quantitative* and *qualitative*, so far as it relates to psychological behavior, is obscure. The function considered by Brickner as chiefly concerned, that of the "elaborate association of synthesizing into complex structures of the simpler engrammic products," is of such diverse and complex character as to affect every conceivable measure of the higher thought processes.

Hebb[1, 2] cites interesting case studies, giving details of cerebral operations and of the patients' intelligence ratings and school performances thereafter. For the small number of cases reported, radical operations on the frontal lobe did not appear inconsistent

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[1] Hebb, D. O.: Intelligence in Man after Large Removals of Cerebral Tissue: Report of Four Left Frontal Lobe Cases. *Journal of General Psychology*, 1939, 21, 73–87.

[2] Hebb, D. O.: Intelligence in Man after Large Removals of Cerebral Tissue: Defects Following Right Temporal Lobectomy. *Journal of General Psychology*, 1939, 21, 437–446.

with average or high mental ratings subsequently. The implication is that a loss in frontal lobe tissue may reduce total activity rather than eliminate special functions. Thus, in the case of a sixteen-year-old boy with large removals of tissue from the left frontal regions and some atrophy of the right frontal lobe, an IQ of 110 was reached on Form L of the revised Stanford-Binet. This was consistent with his previous intelligence as estimated from school performance. One of the most remarkable cases was that of a twenty-five-year-old right-handed male who "had had epileptic attacks for years following the drainage of left frontal intracerebral abscesses." A radical left frontal lobectomy was performed, and four years later an IQ of 152 was obtained, the patient performing without error the Stanford-Binet superior adult tests levels I, II, and III. Performances on the Arthur Scale and the McGill Beta were consistent. The patient, who had been bright in high school, was then a university senior making high marks. As Hebb says:

> With frontal lobe tumors, any deterioration not due to pressure has been taken to mean that the lost abilities or modes of behavior were inherent in the tissue destroyed; moral changes have been accounted for by supposing that a formerly active inhibition has been removed, and inhibition is therefore localized in the frontal lobe. But is there necessarily a mere loss of function? Epileptic attacks show the possibility of a change in cerebral action which is essentially neither an increment nor a decrement. (p. 83.)

Two recent cases [1] are consistent:

> Two cases of surgical excision of scar tissue from the right frontal pole are presented, with anatomical data defining at least the minimal extent of the lesions. In one case a high post-operative psychometric level was discovered.
>
> The result of examination in these two cases is regarded as further evidence opposed to the localization of Binet- or performance-test ability in the frontal association areas. (p. 264.)

In short, we find from Hebb's cases that a frontal lobectomy does not have a marked effect upon mental test performance, although there is "a reduction of activity." It may be that testing based on demands for originality and concentration would show significant differences between these patients and unoperated persons. Viewing the cases as a whole, we should expect a loss of frontal tissue to interfere with the learning of new materials. That there may be exceptions to this, at least over a period of time, is indicated in the case history of the college student mentioned above. As Hebb indicates in his discussion of these cases, the Binet test must be regarded as a crude device, particularly where adult patients are involved. It is not suited for the analysis of losses in mental ability along particular lines. Its meshes are coarse indeed, even for the retention of learned materials. The standard intelligence test, as has been indicated, puts a premium on the fragmentary, the familiar, and the overlearned. It is the category of the about-to-be-learned or should-be-learned (at a high level of abstraction and generalization) that must be regarded as closest to the integrity of the higher lobes. It is suggested occasionally in the literature that it is the diseased tissue rather than its destruction or removal that is responsible for the brain dysfunction generally associated with frontal lobe lesions; that is to say, the diseased tissue is itself not inactive, but disturbing to the unity of the brain. Hence in some cases the removal of tissue may ameliorate the mental condition.

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[1] Hebb, D. O.: Human Intelligence after Removal of Cerebral Tissue from the Right Frontal Lobe. *Journal of General Psychology*, 1941, 25, 257–265.

Of course in all work in which scientific inference is based on only a few cases, it is important to divorce concomitance from causality; always the striking change or recovery in a patient is a fertile field for the old error of *post hoc ergo propter hoc.* As was recently observed in a *Science News Letter:* "One of the most amazing [cases] on record is the case of an unsuccessful stock broker who became a millionaire in a short while following the removal of a portion of the frontal part of his brain, where a tumor was present. . . . Soon he was made a vice-president and is now in the millionaire class. Such brain operations are made only as a last resort to save a patient's life or mentality."

CORRELATES OF INTELLIGENCE

It is impossible to consider a removal of live brain tissue without admitting accompanying changes in neurological dynamics. Intelligence as we have defined it must be regarded as an emergent from the whole brain-in-action. Is it possible that there could be an overgrowth of brain tissue in certain areas such that a reduction in its amount would make for improvement? This conjecture is associated with attempts to improve the condition of schizophrenic patients by the development of high fevers that result in tissue destruction. In pathological cases it is conceivable that there could be excessive brain tissue such that an operation would be genuinely helpful. Still this would not be a true exception to the general concept of a rectilinear relationship between percentage of intact brain tissue and mental ability.

There appears to be no agreement as to how much tissue loss there can be, and in what particular areas, without an observable loss or change in mental activity, even in terms of our present testing facilities. Thus Holmes[1] says that it is the increase of intracranial pressure from cerebral tumors that causes the mental symptoms, this pressure disturbing function by interfering with circulation and the drainage of cerebral spinal fluid. He characterizes most such cases as being apathetic and indifferent with "all the evidences of mental retardation; the comprehension of questions and the answers to them are delayed, and even movements, whether spontaneous or to request, are slow and deliberate. . . . Memory may be equally affected, particularly for recent events, as though, owing to inattention, the patient is unable to fix and retain impressions." (p. 999.) He also cites another type of response pattern frequently associated with frontal tumors in which the patient is "restless, exuberant in conversation and conduct . . . childish in conduct and speech."

Generalizing for different types of cerebral lesions, Nadel[2] says, "The diseased utilize a language which coincides with thinking, with concepts, with ideas that are on a lower level, or at least of a different order of abstraction." (p. 5.) Apparently these diseased persons are afflicted with all sorts of tumors, sclerosis, degeneration, epilepsy, and poliomyelitis. The immediate question is, Are such diseases or deteriorations permanent? Is the loss in abstracting ability permanent? If the organic malfunctioning were temporary we should expect fluctuations in intelligence. All this is consistent with our view that it is impossible to interfere with abstraction without affecting intelligence. All the cases cited by Nadel showed a restriction in behavior on such items as the Kohs block test, color sorting, stick test, the feature profile of Pintner and Paterson, and the Rorschach test.

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[1] Holmes, Gordon: Discussion on the Mental Symptoms Associated with Cerebral Tumors. *Proceedings of the Royal Society of Medicine*, 1931, 24, 997–1000.

[2] Nadel, Aaron B.: A Qualitative Analysis of Behavior Following Cerebral Lesions: Diagnosed as Primarily Affecting the Frontal Lobes. *Archives of Psychology*, New York, 1938, 32, No. 224. Pp. 60.

After reviewing the meager materials above, we must concede the aptness of Lashley's statement:[1]

> The whole theory of learning and of intelligence is in confusion. We know at present nothing of the organic basis of these functions and little enough of either the variety or uniformities of their expression in behavior. The concepts are so poorly defined that it has not been possible even to imagine a program of physiological research which seemed likely to reveal more than superficial relationships. Thus there is really no starting-point for a constructive analysis of the neurological data from these experiments. (pp. ix–x.)

Lashley's operations involved bihemispherical lesions in the brains of rats. He is skeptical about getting at the higher functions.

After reviewing the studies by Brickner and by Penfield and Evans on man and by Jacobsen and others on the monkey and chimpanzee, Harlow [2] says:

> These data might be explained, of course, on the basis of the compounding of simple units, such as conditioned reflexes. Such a theory, however, is faced with a very difficult problem in explaining how lower functions may be seriously affected when higher functions are spared. That this condition may exist is proved by a large body of data, both clinical and experimental. Verbal and manual skills, for example, may be abolished without serious loss to the higher mental processes. (p. 486.)

It is interesting to note the relation of these statements to Lashley's work. If "high" functioning and "low" functioning are different and may or may not go together, the depth of the cut working from the cortex downward will be a dimension to watch. In view of the different layers of the cortex, involving various kinds and concentrations of nerve cells, we may ask, Why is there not more attention paid to the cortical strata that are being disturbed in a given lobe?

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[1] Lashley, K. S.: *Brain Mechanisms and Intelligence: A Quantitative Study of Injuries to the Brain.* Chicago, Ill.: University of Chicago Press, 1929. Pp. xiv, 186.

[2] Harlow, H. F.: The Neuro-Physiological Correlates of Learning and Intelligence. *Psychological Bulletin*, 1936, 33, 479–525.

Similarly, with respect to a lesion in the left or right hemisphere as against lesions in both hemispheres: the surgery needs to be redone to show differentials. If the left hemisphere dominates in the speech of right-handed persons, there should be differentials at some speech levels in relation to this condition. It may be that only recent or higher forms of speech are predominantly in one hemisphere, with rudimentary language penetrating both.

It is a half-truth to say that the frontal lobe is the problem lobe, the abstraction lobe, the planning lobe — perhaps a necessary factor in mental drive. Such statements are clearly unsatisfactory, since the frontal lobe, like other lobes, has no meaning except in relation to the total nervous system. Large portions of a lobe can be destroyed without evidence of real destruction in other areas, but it cannot live alone, it cannot function alone. Probably the frontal lobe has a major role to play in the mental behavior of human beings, larger than its role in lower animals: morphology and parsimony make this a convenient postulate. But exactly what the role is, under what conditions the lobe becomes a basic structure in the field of the abstract, what substitutions could be made as between hemispheres, or as between this lobe and other lobes — these questions call for further experimentation. While serving the same general function, it may not serve this function with an equal potential for all ages, individuals, or physiological conditions.

Some neurological workers hold that it is not the loss of tissue at the site of the injury but the reconstituted nervous system that determines the changes in behavior. However, we may regard this as a play on words. It is like saying, after an operation, that limping is not due to the leg that was amputated but to the special mechanism of a one-legged biped. Truly the brain after some operations has less to do with; if there are not mental changes, what was the function of the tissue removed? Only in the special cases previously mentioned of inferior function in relation to excessive growth or to the presence of deteriorated materials can the results of an operation bring improvement over an intact mechanism. If this means maintaining, with more logic than scientific data, that "brain tissue is good for you" — so be it! The data missing are those that tell us about the changing brain structure as child grows into man and the adult into senility, about preoperative and postoperative conditions long followed on both the neurological and psychological planes, about the incipience of disease and its progress in relation to discovered mental and other behavioral changes in individuals, about the neurology of learning — all for large samplings under specified environmental conditions. It may be an act of faith and nothing more to hold that such knowledge would be relevant to the meaning of intelligence.

It is the brain-in-action that counts, not an obscure, poorly understood organ that Aristotle regarded as a sweat gland and of which, twenty-two centuries later, Crile[1] remarks:

> A large brain is required in man in the arctic for the same reason that a large brain is required in the warm-blooded whale in the arctic, in the warm-blooded walrus, the warm-blooded seal, the warm-blooded caribou, and the Shetland pony, as a defense through high oxidation to maintain the warm-blooded state . . . the large brain of the Eskimo can be accounted for on the basis of the higher requirement for the maintenance of the warm-blooded state in the arctic. (p. 70.)

In short, the Crile-brain is no sweat gland; it is a stove!

Among the psychologists, Kantor[2] holds that persons who think in terms of a physiology of mental functions are showing an intellectual lag:

> Another illustration of the strength of the cortical or brain dogma is found in the interpretation of cortical losses as the removal of the basis for learning, instead of considering that extirpating experiments indicate that brain functions constitute participating actions in learning processes. Were it not for the force of tradition it would seem strange that extirpation data should not be more impressive in creating doubt concerning brain power and trace theories. The conception of the brain as the seat of consciousness, whether or not translated as the seat of control, dies hard. Extirpation workers appear to be surprised that seriously mutilated organisms display inferior performances. (p. 57.)

Here the catchword is "participating." To participate in is not to cause; in this there is no obscurity. But anything participating solely can be removed without causal sequences; this cannot be

[1] Crile, George: A Neuro-Endocrine Formula for Civilized Man. *Educational Record*, 1941, 22, Suppl. No. 14, 57–76.

[2] Kantor, J. R.: Current Trends in Psychological Theory. *Psychological Bulletin*, 1941, 38, 29–65.

said to characterize the tissue-behavior relationship. In passing from complicated brain surgery to gross clinical observations of behavior, we do indeed have so much free play as to make the psychologist, if not the surgeon, somewhat skeptical. Also it is granted that a full knowledge of tissue growth, repair, and deterioration would not, by itself alone, either set the basic psychological problems or pave the way for their solution.

Nature and Nurture

Whenever one speaks of hereditary factors in intelligence, he must speak of hereditary *structures*. There can be no such thing as hereditary behavior in the biological sense. If similar structures lead to similar behavior, it is still not precise to speak of the inheritance of the behavior. A mechanism conducive to walking on two legs is inherited by man, but walking as a complex motor activity is not. A child could take this inherited mechanism and devote it entirely to walking on four "legs," if that was what social models and pressures demanded. The Ubangi lip is more striking than the Hapsburg. The fastest way to get an extraordinarily long neck is not through breeding, but through the collar customs of certain African tribes. The inheritance of these persons, like our own, leads to a standard type of neck under certain environmental controls; under other external controls, the outcome is long necks. To say that refraining from hanging rings about the neck is hereditary is to argue in a circle. The human race, if deprived of its present choices in clothing, food, shelter, and social custom, would choose and stamp in different genetic potentialities. The truth is that man has overemphasized his individuality. If, like the corn plant, he were imbedded in the earth as one of many corn plants, drawing sustenance from the same soil and sunlight, he might get a better idea of himself, not only as a genetic series going back to the beginning of life, but as an item with cross-sectional reference.

Viewing afresh the mind-body problem, we may be struck by a similarity to the physicists' controversy over the nature of light. Is the unit a wave, or is it a particle? It has come to be regarded as both. Is neural activity a swirling about, a signal system, a pattern adjustment, or a restricted transfer of particles? Maccurdy stresses form, pattern, and a laying down of paths and contacts. But we can consider the process of living and dying among cells in nervous tissue, an actual changing about from one dynamic space relation to another — in short, a transporting of particles, with the possibility of loss. A third option is a combination of change in form and gross migration together with electrochemical disturbances.

Carmichael,[1] in discussing the relation between organic growth and environmental forces, points out that marked change in the environment may, over a period of time, show little influence on the growth of an organism, while under other conditions, a slight external change may have a marked effect upon growth. Here we must be careful of adjectives. A radical change in the environment without much change in the organism means that the first term of this coupling is referred to a nonorganic factor. So far as *biological* effects upon live human tissues are concerned, there will be no difference between 5,000° C. and 6,000° C. No organism can remain intact in such an environment nor be differentially affected by this increase in temperature. However, a change of this comparative magnitude, let us say in the temperature at the surface of the sun with related changes on the surface of the earth, might keep the range within human tolerance and be reacted to favorably or unfavorably in terms of human development.

It will help if we accept Dewey[2] on the meaning of environment:

> There are things in the world that are indifferent to the life-activities of an organism. But they are not parts of *its* environment, save potentially. The processes of living are enacted by the environment as truly as by the organism; for they *are* an integration.
>
> It follows that with every differentiation of structure the environment expands. For a new organ provides a new way of interacting in which things in the world that were previously indifferent enter into life-functions. (p. 25.)
>
> Ability to make and retain a changed mode of adaptation in response to new conditions is the source of that more extensive development called organic evolution. Of human organisms it is especially true that activities carried on for satisfying needs so

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[1] Carmichael, Leonard: A Re-evaluation of the Concepts of Maturation and Learning as Applied to the Early Development of Behavior. *Psychological Review*, 1936, 43, 450–470.

[2] Dewey, John: *Logic: The Theory of Inquiry*. New York: Henry Holt and Company, Inc., 1938. Pp. viii, 546.

> change the environment that new needs arise which demand still further change in the activities of the organism by which they are satisfied; and so on in a potentially endless chain. . . . There is, of course, a natural world that exists independently of the organism, but this world is *environment* only as it enters directly and indirectly into life-functions. The organism is itself a part of the larger natural world and exists as organism only in active connections with its environment. (pp. 28, 33-34.)

All processes take time. The schoolboy will say that water freezes at 32° F., knowing that the minute such a temperature is reached skating on the pond is still impractical: energies must be exchanged. In the case of living tissue, complex chemical changes are posited. If a strong poison is administered, these tissue changes will be sudden and sure. Given a mild departure from optimum conditions, let us say in a mineral or vitamin deficiency, the changes will be slow, hard to trace, and yet real and possibly deadly.

The all-or-none principle in nervous reaction has to be reckoned with. As Carmichael[1] says,

> Characteristics of the impulse in the neuron, once its propagation has been initiated, are characteristics of the neural mechanism in question and not of the stimulus. Thus, save in time relationships, impulses in neurons are not "caused by" the stimulus. (p. 453.)

That is one way to put it. Another way is this: different neural mechanisms will be called into play and with varying degrees of violence as differences are discriminated in the intensity or character of the stimulus. The actions are released by stimuli and most of the stimuli come from without. If they are not forthcoming, the neuron patterns retain their readiness, for a while. For the higher mental processes the question is, Will there be a lapse into a period of unreadiness if stimuli do not appear? What must the organism experience in order to project its future experiences into more systematic and abstract patterns? While a response is not "caused" by a stimulus, the organism may lose or change its power of responding, in accordance with the stimuli it receives. A muscle that never contracts, cannot; a joint that never works, will not; a brain that never thinks — well, let us not fall into a trap! Could we say that it "thinks" with greater difficulty or with more reluctance? Of course, to say that "the brain thinks" will satisfy nobody — anatomist, neurologist, or psychologist. It is a figure of speech, like saying "the kettle boils." The brain cannot "think" without supporting neural and muscular mechanisms, without life in the organism, without nutrients in the world, without energy from the sun, and so on into the usual infinity of progression.

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[1] Carmichael, Leonard: A Re-evaluation of the Concepts of Maturation and Learning as Applied to the Early Development of Behavior. *Psychological Review*, 1936, 43, 450-470.

Carmichael regards external environment as the "sum total of all the physicochemical energies releasing neural activity as a result of action on exteroceptors." This definition, like Dewey's, means that an environment does something to an organism; the latter must not remain unaffected by environment, if this term is to make sense. Also, we should undertake to bring environmental forces up out of the realm of physicochemical energies. Different persons produce different effects even though the external chemistry is the same. Let us assume mirror images of two faces reflecting exactly the same amount of light upon the eyes, one face familiar and the other unfamiliar. The response of the organism may be different in the two cases and the difference may be marked, involving high emotional content. We cannot ignore habits, meanings, feelings, and attitudes in explaining these differential responses of the organism. Similarly, by reason of previous suggestion, the image of two concentric rings with a dark center may be construed as the muzzle of a gun or a cross section of iron pipe. Nothing ever to be made available in the physics and chemistry of the image itself can account for the behavior differentials obtained, even though everything that happens will be consistent with all the physical data available for object and person.

Maturation and Learning

That the meaning of intelligence is elusive is evident from common confusions as to the difference between learning and maturation. In the past, theories of intelligence have maintained, explicitly or implicitly, that it could be differentiated from culture, learning, and achievement. Thus one could build up a concept of a highly intelligent person who was extremely ignorant and of a well-informed person who was stupid. For the younger ages of childhood, following Gesell for example, there was supposed to be a mechanical unfolding through genetic or other internal controls. Correlated child behavior was little affected by happenings in the child's external environment. This "lawfulness" lent itself easily to pronouncements on the heritable character of intelligence, that is, of its organic channels. Since an extended discussion of heredity and environment comes later, it is desirable only to point up a few issues in order to clarify the nature of intelligence. While *maturation* is a legitimate concept, it differs only in degree from the abstract learning which is deemed *intelligent.* It is learning at the minimal stages of collaboration between an organism and the milieu in which it is bathed. It means that *if* an organism is to develop, it will follow certain gross patterns — such patterns or none. Thus the human fertilized egg will, at an appropriate level of its embryonic development (but not immediately), take on a conformation characteristic of *Homo sapiens.* It will give up its early resemblance to a chick or a rabbit, for its species is well differentiated from other species. We might expect to go much further along this line, predicting that the human embryo will grow into a skeletal, muscular, and nervous system, of such-and-such type and variety. But we run into difficulties because of the alterations in these patterns that can be brought about by radical environmental changes in the early periods. Since departures from "normal" or "lawful" growth are likely to be for the worse, producing a monster or an inferior organism, the experimental limitations are obvious. We have to depend on results from the lower animals combined with observations on injured, diseased, or deprived human beings.

Under standard conditions of maturation, the organic changes are grossly observable. We can observe increases, plateaus, and shrinkages. While maturation is organic preparedness, it is not an inevitable anatomic outcome. The mature hand is more than an innervated bone and muscle configuration; it is a system of motor controls established through exercise. Maturation can be observed through observation and measurement of the organism and its functions. Thus we can say that in man the thumb that opposes the finger is more "mature" than the thumb not opposed. (Paradoxically the grasping reflex by which a young infant can support its weight is less mature than his subsequent inability to hang on.)

Certainly all the acts and conditions above may be postulated as dependent upon organic change, but nobody is likely to find a road leading from the forest of learning studies to the forest of neurological data. As we have said before, that is not the nature of our problem. The neurologist needs to know some psychology, but he need not know the dozens of categories into which psychological problems have been pigeonholed. They do not constitute a satisfactory blueprint for neurological investigation. The psychologist will not be stopped by any neurological ignorance, nor the physiologist feel lost if he is unable to follow body dynamics into behavior patterns. These levels of discourse have something in common at certain points, and those points are found (for physiologist or psychologist) wherever his experimentation or thinking will be helped. The psychologist is baffled even in his psychology, and occasionally in error, if he persists in ignoring the nervous system. At some stage in his thinking he is likely to make statements that are meaningless or wrong in view of the evolution, the anatomy, or the physiology of the brain. He will, for example, in an unguarded moment, speak of inheritance; since he deals entirely in behavior items, he will be inclined to regard them as data for genetic sequences. It will then take the findings and conclusions of biologists to set him straight.

Discourse on innate ideas long seemed plausible. It took the corrective influence of biologically minded persons to propound the devastating questions, What is meant by *innate?* What is meant by *ideas?* What *processes* are involved? It is again the kind of question being directed toward believers in extrasensory perception: ESP will not be accepted *in psychology*, much less in physiology or neurology, unless the basic mechanisms are displayed.

The lines of *maturation* are comparatively well laid down, while *learning* has great scope and flexibility. Except at the most primitive organ levels, maturation is not a necessary condition for the survival of the individual organism, provided that others will take over the nourishment and protection of the weaker group members. No one need ever learn a language, or a musical notation, or anything at all in the abstract. What is higher and what is lower learning is determined in accordance with changing criteria. But what is mature or immature is easily arrived at; for example, throughout human history it has been considered more mature to walk than to crawl, to crawl than to sit up, to sit up than to lie down. Following Gesell, we could build a fairly elaborate maturational pattern out of these little hierarchies of muscular control and locomotion.

There will come a time when we shall want more hierarchies of *abstraction* than are now considered necessary or desirable. In the public schools and higher institutions, we have gone a little way in pushing minds up to their higher levels of performance. But schooling is still a rare phenomenon in the world taken as a whole. In American education we have yet to learn to sacrifice large amounts of casual information in order to generate thinking, planning, and producing at high levels.

Physiological change accompanies or conditions reduced function. It cannot be specific unless it results in a *loss* of something previously learned. We forget "because of" lesion, atrophy, or inertness of tissue. If a new word to be learned is of such an order of abstraction as to be beyond the mental effort that can be mobilized — that is, the needed channel is not there or is not available — then the learning of *any* word of this level of abstraction is therebv contra-indicated. To quote Goldstein:[1]

> Amnesic aphasia is not caused by a lack of words or a lack of ability to call up word images. On the contrary, the symptoms shown by the patients are caused by a change in their basic behavior. The patients have lost the categorical behavior and are reduced to a mere concrete level of behavior. . . . The fact that the loss of the meaning of words is accompanied by such a great change in the world of the patient shows clearly that *language does not merely reflect the world to the mind,* but that it is a means itself for building up the world in a particular way, i.e., in the abstract categorical way. . . .
>
> We can build simple connections between an object and a word and also between two objects. We do it for example in learning words in a foreign language, as in vocabularies. So long as we have not yet a conception of the foreign language we possess the words only as a superficial connection with the words of our own language. Also, some words of our mother tongue always stay in such a super-

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[1] Goldstein, K.: The Problem of the Meaning of Words Based upon Observation of Aphasic Patients. *Journal of Psychology,* 1936, 2, 301–316.

> ficial connection with things, until we gain the meaning of these words. Then the words achieve an absolutely different character. Then they become representatives of the mentioned categorical approach to the thing, to the world in general. (p. 315.)

Specific word blocks may involve a positive interference from other learned, perhaps emotionally tinged, items. In the ordinary nonpathological, nondeteriorating case, forgetting does not indicate that new learning of the same order as the forgotten materials may not be undertaken. It is customary to keep on learning new things while forgetting the old, although new things are harder to learn than things previously known. In a true deterioration, such as may be related to a brain lesion, there is a loss both in recall and in the ability to take on new learning. Anyone would be startled if, having forgotten something, he could not relearn it, although this is what accompanies brain operations, psychopathologies, and senile conditions.

Is this contrary to human experience, namely that in times of stress it is important to call upon old men, for their wisdom will prevail? Let it be understood that the wisdom that prevails is often that of conservation, of the *status quo*. The truly wise old man surrounds himself with younger heads that can carry on in the mental tradition of his youth: to their mental work he gives the stout support that springs from well-established personal and social qualities. While intelligence declines, such virtues may continue an upward swing.

PART II

THE MEASUREMENT OF INTELLIGENCE

CHAPTER III

THE BACKGROUND OF MENTAL TESTING

The aim of this part is to present a review of testing procedures in relation to the problem of intelligence. This is not a handbook for psychometrists or for the makers of mental tests, although it will offer some criticisms and suggestions. The plan is to throw mental tests against a background of what they might be, and to offer some interpretations of what they mean.

Quintilian, who was born in the year 35 A.D., made the following observation:

> It is generally, and not without reason, regarded as an excellent quality in a master to observe accurately differences of ability in those whom he has undertaken to instruct, and to ascertain in what direction the nature of each particularly inclines him; for there is in talent an incredible variety, and the forms of mind are not less varied than those of bodies.[1]

From the ancient days there has been a recognition of differences along mental lines, together with crude ways of distinguishing one man from another in terms of vocational or social fitness. Even when conditions of wealth or nobility tended to override differences in intelligence and sanity, the common man, no less than the expert adviser, would undertake gross ratings: occasionally the royal purple was seen to mask men who were dull to the point of feeble-mindedness or queer enough to be called mad.

THE EARLY WORKERS

At all times, proposals for the measurement of differences in ability drew upon the particular school of philosophy or psychology that flourished. Thus in the eighteenth century, "mental faculties" that were minute abilities for everything, including the processes of intelligent behavior, led finally into the sterility and error of phrenology. The classic associationism turned the attention of workers to the sensory processes. For a long time its theories permeated psychological approaches, the individual child or adult tending to be lost: whatever was needed to make the organism work, think, feel, and respond was assumed to exist. There was above man, or within him, a transcendent *something* which determined his essential quality.

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[1] Quoted from William Boyd, *The History of Western Education.* London: A. and C. Black, Ltd., 1921. Pp. xi, 443. (p. 76.)

In the nineteenth century, Galton[1] made real headway, so far as methods of making discriminations, distributions, and correlations were concerned. He was instrumental in building up a tool of analysis, but he applied it to what the ruling psychologists proposed, namely the sensory processes. It was plausible to him, as to many lesser minds, that acuities in vision or hearing or weight discrimination should indicate differences in mentality. Because of his satisfaction with the evidence from such processes, his idea of studying widely spaced groups did not yield fruitful results in mental testing. Similarly, his work on the inheritance of mental traits, which would no longer pass muster among technical psychologists, led to a research progeny whose validity has likewise been questioned.[2] Penetrating psychologists like Cattell [3] were blocked in similar fashion, as is shown by a listing of his tests:

Dynamometer pressure.
Rate of movement.
Sensation-areas.
Pressure causing pain.
Least noticeable difference in weight.
Reaction-time for sound.
Time for naming colors.
Bi-section of a 50-cm. line.
Judgment of 10 seconds time.
Number of letters remembered on once hearing.

In the series above, only the test on rote memory would yield much as a measure of intelligence, and this would be lost if scored only as a part of the whole series.

Gilbert, in the first study published in the University of Iowa

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[1] Galton, Francis: *Inquiries into Human Faculty and Its Development.* London: Macmillan & Company, Ltd., 1883. Pp. xii, 387.

[2] Galton, F.: *Hereditary Genius: An Inquiry into Its Laws and Consequences.* London: Macmillan & Company, Ltd., 1869. Pp. vi, [2] 390.

[3] Cattell, J. McK.: Mental Tests and Measurements. *Mind,* 1890, 15, 373–380.

Studies in Psychology,[1] reported upon a series of tests given children aged six to nineteen. Again the list of tests is revealing:

Pulse both before and after the series of tests.
Pain threshold.
Strength of lift with the wrist.
Strength of lift with the arms.
Estimation of length by arm movement.
Estimation of length with the eye.
Lung capacity.
Weight.
Height.
Voluntary motor ability.
Fatigue.

With respect to the relation of these tests to "mental ability," Gilbert says:

> After the tests [listed above] were completed, the record cards were returned to the respective teachers who were asked to mark each name with a figure 1, 2 or 3, according to what she considered the mental ability of the child to be, marking the bright ones "1," the average ones "2," and the dull ones "3." This is the same method as that which I followed in my New Haven tests in order to avoid the inaccuracy arising from using examination grades as a standard of the mental ability of the subject. Those subjects taken from the University were marked from the University records of their standing, because no teacher in college work has the student in more branches than one, as a rule. In the Iowa City High School they were marked by the teachers when together at one of their "teachers' meetings." (pp. 32-33.)

It is small wonder that Gilbert (like many others in these early days) was able to conclude as follows:

> My data show no such relation between weight and height and mental ability as has been claimed, but give a negative result, and if any positive result can be stated at all, it would be that the taller and heavier the children the duller they are, instead of the opposite. The marked differences occur between ages 10 and 14. By referring to the charts for graded weight, lung capacity, and wrist lift, it will be seen that they all follow approximately the same law. (p. 39.)

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[1] Gilbert, J. Allen: Researches upon School Children and College Students. *University of Iowa Studies in Psychology*, 1897, 1, 1-39.

Binet[1] reviewed Gilbert's study at length, remarking dryly at the end, "*La question reste donc ouverte.*"

The German psychologist, Ebbinghaus, came closest to the concepts that Binet, Henri, and Simon finally brought into a workable form for the measurement of intelligence. In his well-known completion test he had hit upon a device that got below the skin surface and below the sense organs with their special innervation; he had arrived at a measurement of a central higher process. (It was about this time that Binet and Henri, in a series of articles in *L'Année Psychologique* (1895–1898), described an intensive study of subtests and of a composite for the measurement of the higher complex functions. They were interested in tests of memory, imagination, attention, and comprehension. It is true that at first they mingled with these a number of sensory and physical tests, but they were on the right path.) In America, in the meantime, the Titchenerian school of psychologists, following Wundt, was impressing a whole generation of students with the importance of sensory and physiological psychology. They were not sympathetic to these newer nonexperimental, clinic-type approaches, but they produced the Sharp-Titchener study[2] which dampened further efforts in this country toward the validation of Binet materials. It is seen now that there were two weaknesses in the study: (1) it was based on a small number of advanced students in psychology, thus tremendously reducing the range of talent, and (2) its tests of memory, imagination, attention, and description were only mildly representative of the attributes that Binet was then defending. Even so, the results were not entirely unfavorable to the tests. Similarly, studies of Cattell's tests mentioned above did not yield good indicators of variability in test performance as related to scholastic marks. In short, the early American workers did not use good tests and they did not score them well. They were unimpressed by sampling needs, and they were unable, with their strong attachment to laboratory procedures, to give a sympathetic account of the incipient discoveries that were nevertheless being made.

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[1] Binet, A.: J. Allen Gilbert. Researches upon School Children and College Students (*Recherches sur les enfants d'école et les élèves de collège*). *Studies in Psychology*, pp. 1–39, Iowa, 1897. *L'Année Psychologique*, 1897, 4, 653–659.

[2] Sharp, Stella E.: Individual Psychology: A Study in Psychological Method. *American Journal of Psychology*, 1898–1899. 10. 329–391.

ON THE MEANING OF TERMS

For practical purposes, the words "test" and "measurement" may be considered synonymous. In the physical sciences, measurement has a more precise meaning in the sense that it involves a comparison with a fixed standard, as in the gram or the meter. A similar operation may be performed under laboratory conditions in psychology. We can measure a just noticeable difference, a speed of reaction, or the time and errors comprising a standard learning series, measurement being construed as the application of standards to a particular set of materials, data, or phenomena. A test is more likely to be a method for determining the presence or absence of something, as in a test for arsenic or albumen. In psychological measurement, we may test a person's knowledge of the spelling or meaning of a word. In psychology and education generally, these concepts of measuring and testing are expanded to include what happens when the same tasks or questions are presented to a stated population. It is often more revealing to discover this comparative standing of an individual than to present merely the "raw data" obtained from reactions to specific items. This meaningfulness that comes from classification or rating is important in many nonpsychological areas of human activity. In American college circles, the statement that John Smith has run 100 yards in $9\frac{6}{10}$ seconds reveals an extraordinary accomplishment. On a priori grounds there is no occasion for knowing whether a man should run 100 yards in 8 seconds or 20 seconds. But Smith is immediately placed against the background of the thousands of men who, having run their best, could not get under 10 seconds. Popular discourse without the use of technical terms nevertheless arrives at usages analogous to centiles, sigma scores, age-scales, and quotients.

If intelligence is what we have taken it to be, then we may enter any testing situation to see whether or not the attributes are included. This procedure would involve a valid operation, let us say for the determination of abstraction as against nonabstraction, and for degrees of abstraction if they are discernible. Weight lifting as such might be excluded on a priori grounds because of its obvious relationship to strength. But the discrimination of small weights (well below the muscular power of the child being tested) is a problem-solving situation that has long been regarded as a mental test. It is probable that something can be added to success in weight lifting through superior mental ability, but it takes an experimental situation rather than a simple test item to resolve the matter.

We can test a child's ability to spell "mouse." With more tests of that kind, we can measure his spelling ability, that is, how he stands with respect to other children. This will involve a system of numbers and scores in order that we may tack down something that transcends time, space, and special circumstances. This process in psychological testing, as in common speech, protects us from futile proliferation. It gives us symbols that are easily manipulated, although they do not in themselves represent psychological realities. In a pure form there is no difficulty with such conventions as addition, multiplication, zero-point, or change of sign. While scores in intelligence tests are added and correlated with facility, it is obvious that these operations may produce a strain upon both mathematical and psychological theory.

Brigham [1] suggests caution:

> The diversion of psychologists from general debates on the question of the nature of intelligence to the more careful analysis of test scores has resulted in several important advances. The question immediately arises as to whether or not the test score itself represents a single unitary thing. This question is crucial, for if a test score is not a unitary thing it should not be given one name. . . . Most psychologists working in the test field have been guilty of a *naming fallacy* which easily enables them to slide mysteriously from the score in the test to the hypothetical faculty suggested by the name given to the test. Thus, they speak of sensory discrimination, perception, memory, intelligence, and the like while the reference is to a certain objective test situation.
>
> A far-reaching result of the recent investigations has been the discovery that test scores may not represent unitary things. It seems apparent that psychologists in adding scores in the sub-tests in some test batteries have been doing something akin to adding apples and oranges. (pp. 158–160.)

Were we to follow this line of reasoning too literally, we could not even add apples! What does it mean to add fifteen immature crab apples to five full-blown king apples? Addition, like other mathematical processes, is always pure. We are free to apply it to dissimilar objects if this seems to be helpful. The use of the word "general" as applied to human abilities, characteristics, and achievements illustrates a common need for a synthesis that represents long-enduring judgments of character, intelligence, and stability.

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[1] Brigham, Carl C.: Intelligence Tests of Immigrant Groups. *Psychological Review*, 1930, 37, 158–165.

The human mind took a tremendous step forward in the exploitation of its organic substance when it reached from the concrete and the discrete to the symbolic and abstract. The testing of all-round mental ability in any individual will go beyond the abstract to its effective linkage with problems to be solved in a given social milieu. In dealing with discrete objects that can be counted without error we can be explicit as to the outcomes. But these simple conditions are rarely found in psychological testing or in any situation that deals with human development. When we say that a boy is 4 feet tall as measured by an expert, we assume that there is little error in the measuring stick and in applying *whatever method of measurement was agreed upon.* Standing height is different from prone height and height in the afternoon is different from height in the morning.

We know further that errors of measurement will creep in. As we go up from the physical and motor types of measurement into determinations of the presence, quality, and intensity of behavior items, the errors of all types increase. In mental testing we sacrifice objectivity and exactitude in order to get insight into comparative standing. It is as if in the 100-yard dash we paid little or no attention to the time elapsed but said merely that Bill Smith performed as well as the top man in one hundred qualified runners, while the performance of Joe Smith was average. Viewed as a quotient the first feat might yield a centile rating of 99, and Joe's performance, 50. The actual difference in time elapsed over the 100-yard stretch need be only a second.

The laws built up about the behavior of molecules, for example the gas law, do not refer to the behavior peculiar to a single molecule. The gas law is an average. During the flow of liquid through a pipe some molecules may spiral or turn back for a time. Similarly, the atomic weight of an element does not give us the relative weight of any single atom. What we obtain is an average. If the heights of American boys taken on their tenth birthdays were measured with never less than two million in the sample, let us say over a stretch of one hundred years, the obtained height would be so constant (or so steadily changing) as to look like a "law." We could talk about constancy or trend in the grand fashion of engineers. Some psychological observations are analogous to the study of individual molecules or of small clusters. They are perhaps like the work of Millikan, Anderson, and others in bombarding electrons in a gas chamber, tracing the course of unique events, and plotting it statistically if that proves helpful. Actuarial science tells us nothing about the actual growth process of any living person; it simply builds up a table of expectations based on what has happened to many individuals. There is no sure force in nature that prevents a man living to the age of one hundred and fifty years, but there is a probability or an expectation based on carefully kept records of men under many conditions of heredity and life experience. There are also expectations based on descending or ascending curves, for example that at the present time any American child will become taller than his forebears.

There is nothing happening within the organism itself at the time of the display of intelligent behavior that will give us a useful external clew. If differences in the character of the brain waves were associated with thinking or nonthinking, or with effective thinking as against ineffective thinking, we should have little more than a crude indicator. Similarly, all the attempts to associate intellectual activity with gross sensory and motor capacities have proved barren. There is nothing in the physical behavior of the person that reveals what we want to know, namely, what level of intelligence the organism is applying to a problem. This capacity we must infer from the measurement of achievement in validated materials. We postulate a uniformity of nature which will permit a person who has passed a test to pass other tests equally saturated with demands on intelligence. Since the test items are sometimes chosen as representative of actual problem situations we make the further assumption that test intelligence is highly related to, if not equivalent to, life intelligence. There would be no objection to this if the testing situations offered in reality a better prediction of intelligent behavior than any given sector of life, however long. To quote Stoddard and Wellman:[1]

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[1] Stoddard, George D., and Wellman, Beth L.: *A Manual of Child Psychology.* New York: The Macmillan Company, 1936. Pp. v, 117.

> It is necessary to avoid the error of believing that things contributing to the same general function must themselves be alike or look alike. A task may be performed with or without verbalization, and the two acts appear grossly unlike, yet they may make essentially the same contribution to a pattern of intelligence. For example, the placing of one cube on top of the other by a child may contribute to the measurement of intelligence as adequately as the definition of *pity* fifteen years later.
>
> In measuring intelligence, we are getting at not only ingredients of the whole pattern, but at indicators, surrogates and prognosticators. We need not bother at all about the external appearance of our tests if they are shown (*a*) to be, or to be related to, (*b*) to be surrogates of, or (*c*) to predict the likelihood of, *intelligent behavior as defined.* If the goal is not so much to measure intelligence as to analyze the whole behavior pattern of the child, we are of course justified in focusing our attention upon any practical aspect of development or behavior, such as motor skills, speech or ability in spatial relations. (p. 45.)

A special order of confusion in mental testing may result when neither the test constructor nor the consumer agree upon the meaning of intelligence. The author or reviser of tests tends to become opportunistic and wasteful, since he likes to use materials already selected and partially standardized. Binet, who provided most of the gold in the hills of mental measurement, has been mined assiduously for a quarter century. The mental tester, as a rule, is a clinical psychologist or a school worker faced with a problem of pupil failure. If he wants practical results, the following paragraph from Kent[1] illustrates the problem:

> When a child of reading age is referred to the clinic because of his failure to learn to read, it is of the first importance to ascertain whether his mental capacity is or is not within normal limits. A composite test which contains reading matter for the subject discriminates against the subject whose inability to read is due to any cause other than mental retardation. A test which calls for oral response discriminates very seriously against the child who by reason of speech defect or impediment is unable to make himself understood. It is little more than a farce to use a timed test or a test containing timed items for a psychotic subject whose mental processes are pathologically slowed up. What we measure by the test may be significant, but it is something quite other than what the test is intended to measure. (pp. 422–423.)

[1] Kent, Grace H.: Suggestions for the Next Revision of the Binet-Simon Scale *Psychological Record,* 1937, 1, 409–433.

Clearly the ability to read is in itself a measure of intelligence. A speech defect is unimportant unless it hinders the subject's own mental operations; in mental measurement there has not been any test of the ability of a subject to give instruction to other subjects. In the case of a *timed* memory test the inability of a stuttering subject to get down the sentences within the limits provided is as true a failure as that expressed by a subject who cannot recall the text. Otherwise the test item has been poorly standardized. Similarly for psychotic subjects: their slowing up in mental test responses is in itself a mark of test failure. It would be hard to find a better harmony as between the results of mental testing and the facts of mental deterioration than that displayed in the slow, discrete responses of schizophrenics.

Practically it would appear feasible to have a nonoral alternate test for children with speech difficulties. Their responses could be written. Similarly for deaf or blind children: so far as the entry into the behaving area of the child is concerned, this could be accomplished in any appropriate medium and they could give their responses in any medium. This would not call for a complete restandardization of tests, but for alternate methods of giving and recording. The saturation with the attributes of intelligence should be exactly the same, with the probable exception of the attribute of economy. Any substitute for oral, auditory, or visual processes might entail a loss in speed. In any case gross speed is only a small portion of the attribute of economy. The main loss of time is that indicated in photographs of the eye movements of poor readers, namely, the fumbling that comes from a lack of comprehension, a mental turning around and about in advance of a solution.

The case of Helen Keller illustrates the feasibility of getting at the attributes of intelligence as differentially expressed among individuals. Why do we say that she is high in abstracting ability? We support this statement simply by quotations from her works. The paragraph that follows is an example; from the standpoint of the definition and measurement of intelligence, we care little how Helen Keller reached the ability to understand and experience so much.

> I have walked with people whose eyes are full of light, but who see nothing in wood, sea, or sky, nothing in city streets, nothing

> in books. What a witless masquerade is this seeing! It were better far to sail forever in the night of blindness, with sense and feeling and mind, than to be thus content with the mere act of seeing. They have the sunset, the morning skies, the purple of distant hills, yet their souls voyage through this enchanted world with a barren stare. The calamity of the blind is immense, irreparable. But it does not take away our share of the things that count — service, friendship, humor, imagination, wisdom.[1]

In a nutshell, the confusion is this: if we find some external physical "reason" for poor test performance, we tend to discount the testing; if the "reason" remains obscure, locked up in the internal mechanism of the organism, we tend to accept the results as bona fide. A recent paragraph from Wallin [2] retains this trace of the ghostly tradition:

> To conclude from test findings, even though they have been adequately documented and are not spurious because of the imperfections in the tests or in the rating techniques or for other reasons, that an individual's intellect has improved 50 IQ points or deteriorated 50 IQ points may represent an inductive leap beyond the premises. All that the deterioration revealed by the tests may mean is that the outlets of expression have been impaired or blocked by obstructions, temporary or otherwise. IQ gains might likewise be due to facilitations or excitations of the neuromuscular apparatus, temporary or otherwise. (p. 387.)

Neither test constructor nor clinician hesitates to say that a child's brightness has remained static when the IQ is constant; when he finds the IQ inconstant, particularly if the change is radical, then what has changed is something other than brightness!

Again we need not worry about the palatableness of test items for adults, *provided the items themselves conform to a good concept of intelligence.* It is irrelevant if adults regard some of the items as unfair and therefore refuse to respond to them adequately. Since the items presumably are indicators of intelligent behavior under other conditions (in the so-called life situations), we may expect some adults to fail on the "real" issues. The mature person does not show a distaste for the abstract, even though it has long been identified with the schoolwork of children. He is not misled by superficial resemblances, but continues to bring to any problem his full complement of mental resources. I am reminded of an anecdote related by the distinguished geographer, Isaiah Bowman. One day at the end of the school term in the sixth grade, his daughter came home remarking gaily, "Daddy, I'm all through with geography!" Millions of American children have been "all through with geography" by the age of twelve only to discover, at the age of twenty-one, that the problems in this ramified discipline have some basic connection with their lives and fortunes.

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[1] Keller, Helen: *The World I Live In.* New York: D. Appleton-Century Company, Inc., 1908. Pp. xiii, 195 (pp. 84–85).

[2] Wallin, J. E. W.: The Results of Multiple Binet Retestings of the Same Subjects: The Educational Implications of Variation of Test Performance. *Journal of Genetic Psychology,* 1940, 57, 345–391.

The man-in-the-street, not to mention the teacher, physician, or judge, likes the dichotomous couplet, especially if one of its terms can be used to condone conspicuous failure. Guilford[1] has pointed out that the tendency to regard dullness-brightness as a single dimension of mind probably stems from Binet's original assignment which called for a separation of scholastic "sheep" and "goats" among Paris children. What had been mental testing was subtly transformed into the measurement of intelligence. Unfortunately the logical demands of this shift were slow to be recognized.

CULTURE AND MENTAL TESTING

We can distinguish intelligent behavior from other behavior if we make appropriate definitions and measurements. It is not necessary that the concept be excluded from other measurements. A wide-range test of mathematics or of reading comprehension is certain to be in part a test of intelligence, but it may not be standardized as such; it may remain simply, for example, a test of mathematical knowledge. Without a clear formulation of the nature of intelligence there will always be a mixture of intelligence and nonintelligence items in any testing proposal. Thus Cattell[2, 3] and others imply that a culture-free intelligence test would be an improvement over culture-permeated intelligence tests, losing sight of the fact that it is in the upper strata of cultural enterprise that the highest, that is, the most abstract and complex, measures of intelligence may be expected. In reducing everything to a lowest common denominator, we smooth out differences in insight and achievement that are themselves indicative of true differences in mental ability. This is like comparing the communication system of a civilized country to that of a primitive country without recourse to the telephone or the radio. Cattell adheres to the position "that a perceptual intelligence test could be built out of relationships from fundaments in any sense modality, seeing, hearing, tasting, etc." Surely Cattell has understated the case. Sensory differences are bound to be crucial in any such testing, and directions calling upon oral or reading comprehension (which the testing of sense perceptions ordinarily involves) are inaccurately weighted when reduced to the rank of a fore-exercise. Moreover, there is no way to prevent verbal-minded persons from attempting, and perhaps succeeding in, verbal solutions to certain types of nonverbal problems.

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[1] Guilford, J. P.: Human Abilities. *Psychological Review*, 1940, 47, 367–394.

[2] Cattell, Raymond B.: A Culture-Free Intelligence Test I. *Journal of Educational Psychology*, 1940, 31, 161–179.

[3] Cattell, Raymond B., Feingold, S. Norman, and Sarason, Seymour B.: A Culture-Free Intelligence Test II. Evaluation of Cultural Influence on Test Performance. *Journal of Educational Psychology*, 1941, 32, 81–100.

At the same time there is nothing in the commonness of cultural items which acts against their use in intelligence tests at the lower levels of comprehension. It is when the test-maker gets over from the naming and relating of objects in a physical environment to interpretations of their meaning and to the behavior of children and adults, that he leaves the common intercultural ground; he will not be able to standardize such materials across cultures. For a culture that has employed and developed symbolic and language procedures, their deletion from a mental test program distorts all measurement and comparison.

To the reader it may appear that we have overemphasized the necessity of clearness in defining or delimiting intelligence. Yet we could fill a large notebook with illustrations from the current literature of a desire to separate, once for all, the forces of nature and nurture. (This will be dealt with in some detail in Part IV.) The question is, How do such ideas affect our concepts of measurement? A statement by Conrad[1] will illustrate the difficulties. Speaking of an "ideal" test of adult intelligence, he says:

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[1] Conrad, Herbert S.: The Measurement of Adult Intelligence, and the Requisites of a General Intelligence Test. *Journal of Social Psychology*, 1931, 2, 72–86.

> The test should measure *innate intellectual capacity*, rather than acquired intellectual ability; or, if the measurement is of both, it should, ideally, be possible quantitatively to separate the measure of capacity from the measure of ability. At present, awaiting an authenticated physiological or anatomical method of measuring intelligence which yields sufficiently high validity coefficients (and which, in comparison with mental tests, is relatively insusceptible to a variety of uncontrollable embryological, physiological, environmental, and emotional factors), — at present, we are forced to *infer* innate capacity from measured acquired ability. (p. 75.)

Conrad's view, which is rather widely held, is relevant because of the nostalgic desire on the part of testers sometime, somehow, to construct a test that will not vary with environmental pressures, in the hope that such a test would measure pure intelligence. Nevertheless the nature-nurture question (which can be applied only to individual differences in a population) can be resolved only in terms of mental tests that disregard it.

G. L. Freeman,[1] too, believes in standardizing experience in the absence of language in order to go more "native." In his proposals for mental testing, he reduces experience to a minimum, believing that nonsense syllables can carry the load. Freeman would reject a test if differential school experience affected the child's rating. Is this tenable? Rather the test, under such conditions, should be rejected *if it fails to discriminate in intelligence.* If intelligence is truly affected by school experience, then we shall never measure it validly by a test unrelated to experience. This would be like trying to get a test of muscular power, or of muscle size, that was unrelated to the amount of exercise experienced by the muscle. The brain is no muscle-bulge, but its tissues are alive and responsive and it is organized in terms of experience.

Now if there ever was a time to measure "innate intellectual capacity," infancy would appear to be indicated, for there we have nature in its purest form. Adult minds, like adult foods, clothes, machines, houses, farms, factories, and vehicles, are far removed from any "natural, crude discrete forms." A full analysis of a mountain of iron ore will not reveal the forthcoming locomotive, nor will all the analyses of all the crude materials entering into its construction. If we knew everything about the "innate capacity" of an adult human being, we should know little about his intellectual status. A concept of *native capacity* that runs unchanged through the indeterminism of prenatal and postnatal life, and up through the vicissitudes of childhood and adulthood, is not revealing of mental growth, *except as a limiting factor.*

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[1] Freeman, G. L.: A Methodological Contribution to the Nature-Nurture Dilemma in Tested Intelligence. *Psychological Review,* 1940, 47, 267–270.

Nobody denies that geographic and cultural conditions affect the validity of items in mental tests and therefore the interpretation of the scores obtained. This is far different from saying that the measured differences are superficial or transitory. In the case of foreign-born children or children of foreign-born parentage, it is not without meaning to apply to them good mental tests, if they continue to study and work in an American culture. Theoretically one can have an intelligence rating with English and Cherokee as subscripts. What then is the nature of the *intelligence* of the child? The answer, of course, is that there is no "intelligence" of the child conceived in universal terms, but only comparative behavior in certain defined areas. Under one set of conditions a child may be bright, and under another, dull. There is no point in trying to get from one to the other, except in terms of probability. A child who has been judged bright in a Cherokee test would probably be judged bright in American testing or school situations. This comes about not only through the constant factors in the child's organic make-up, but because of the overlapping cultural demands. Like other Indian or white children, he might be rated permanently dull in a primitive society whose validation of a "mental" test was confined to differentials in physical prowess. A society that had prepared tests, say of the ability to spear fish under specified conditions, would have no occasion for turning to outlandish standards. In school and clinical situations, we do "make allowances" for all kinds of cultural and organic deviations that appear unimportant. Thus a difference in accent or clearness of speech, while retaining social connotations, need have no bearing upon the course of mental growth. But any residual necessity to count on the fingers and other anatomical points would keep the tribal child below his full potentiality in a culture that had developed mathematical usages.

To grow in intelligence is not only to acquire new and better intellectual tools, but to show characteristic progress through their utilization in actual problem solving. Potential intelligence need not extend to measured ability. It is like saying that William Jones II, son of William Jones, Harvard '03, would have matriculated at his father's alma mater — had he not died in infancy! In intellect every person is only what he could be; moreover he is nothing he has not become. There is no harm in the concept of potential intelligence so long as we regard it as an *estimate* of what can be salvaged at some later period. Intelligence as measured is a status intelligence and needs no qualifying term. In fact, it should be cut off from the idea that it is a permanent or future intelligence. We are interested in this later intelligence, but getting at it by extrapolation is not trustworthy: far better to devise appropriate tests at all ages and to count upon frequent measurement. Intelligence is analogous to health; any estimate of it should be rechecked close to the making of an important decision. The concept of optimum intelligence refers to potential intelligence as developed under the best of stimulation. We can do no better in prediction than to turn to what actually has happened to growing children. Presumably what any child has done can be done again, but a measure of this calls for a comparison over intervals of mental growth.

For all kinds of test items it is possible to equate the attribute of difficulty. The other attributes will vary. The mental profile can be constructed accordingly. We need not be concerned about intercorrelations or the overlapping of functions, for if each function is explicitly defined and measured, the "overlap" becomes another way of stating that certain human abilities come in clusters. A possible remote convergence in terms of growing organic structure does not disturb the validity of behavior patterns that are judged psychologically different.

BINET AND SIMON

Since the basic ideas and test materials of Alfred Binet form the hard center of the Stanford and Kuhlmann revisions, it may be well to revert briefly to some origins. Binet's central concept of intelligence, outlined in *L'Annee Psychologique* series, involved three principal points: (1) a goal or direction to the mental process; (2) the ability to make adaptations by means of tentative solutions; and (3) the ability to select, to make good judgments, and to criticize any postulate or solution. While the tests did not closely conform to these principles, there was built up in the various French revisions a practical procedure involving requests for information, words, answers, and concepts, all tending to reflect a comprehension of the life about the child.

The Binet-Simon tests sprang from a first-hand knowledge of children in school and hospital. As is well known, Binet's original assignment in 1904 from the Minister of Public Instruction in Paris was to discover some method of rating children who were likely to fail in school: how could the subnormal children be found and eliminated, and what did they need by way of special schools? Hence theory was always tempered by the practical necessity of showing results. If a test item seemed to offer a good lead, it was improved, and perhaps extended to a further range of testing. If it offered no discrimination, it was rejected. In this manner, from a pool of test items which were not the exclusive product of the Binet workers, but in some cases had been current in Europe and America, Binet was able to select the items that proved effective, and to add to them in a systematic fashion.

Binet was strongly motivated by a desire to do something for children; he brought into a testing situation which had become formalistic and sterile a positive devotion to such ends. These sentiments encouraged him and his followers to make a direct child-tested attack upon the problems. Thus in 1902 Binet had made an intensive study of his two daughters, with special reference to their language usage. This study followed eight years of interest in similar projects during which time, along with Henri, he developed memory tests for words and synonyms, together with tests of accuracy, all-round judgment, reading comprehension, and ingenuity (the paper-cutting test). His later collaborator, Simon, a physician in charge of a hospital, had noted that the feeble-minded were being poorly diagnosed. His clinical and medical interests tied in nicely with Binet's scholastic approaches. The technical outcome of this collaboration was the Binet-Simon 1905 scale entitled *A Metrical Scale of Intelligence* in which the subtests were arranged in an increasing order of difficulty and the results for each child were compared with an average for children of the same chronological age. Their estimates of average ability, of retardation, and acceleration were based on agreements with or departures from this standard. The concept of mental age was already taking form. In France they have continued this usage without recourse to the intelligence quotient. A description of these tests is found in Whipple's *Manual of Mental and Physical Tests.*[1]

In the 1908 scale, entitled *The Development of Intelligence in Children,* the fifty-eight items were arranged in child ages three to thirteen, and a large number of children was employed in the standardizing sample. Tests were placed at a point where from 50 to 75 per cent of the children passed. By this time, Binet had definitely developed his idea that a child grows mentally and that his rate of growth in comparison to an average rate of growth gives an important practical discrimination. He also approached closely to the concept of a normal distribution, observing that, for a given set of tests, a few children would fail, many would pass, and a few would score very high. He also committed the tests to a validation by checking with scholastic ratings, a concept that has dominated individual mental testing to this day. In the last revision in 1911 (the year of Binet's death) there is an extension upward of the range of testing. Binet had no objections to carrying tests below the age of three years, and shortly before his death developed a few minor tests starting at the three-months' level.[2]

The opinion of Binet and Simon on the meaning of intelligence, with special reference to the factors considered measurable, is clearly given in Kite's translation:[3]

> But here we must come to an understanding of what meaning to give to that word so vague and so comprehensive, "the intelligence." Nearly all the phenomena with which psychology concerns itself are phenomena of intelligence; sensation, perception, are intellectual manifestations as much as reasoning. Should we therefore bring into our examination the measure of sensation after the manner of the psycho-physicists? Should we put to the test all of his psychological processes? A slight reflection has shown us that this would indeed be wasted time.

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[1] Whipple, G. M.: *Manual of Mental and Physical Tests: A Book of Directions Compiled with Special Reference to the Experimental Study of School Children in the Laboratory or Classroom.* Baltimore, Md.: Warwick & York, 1910. Pp. xix, 534.

[2] Binet, Alfred: *Les Idées Modernes sur les Enfants.* Paris: Ernest Flammarion, 1909. Pp. 346.

[3] Binet, Alfred, and Simon, Th.: *The Development of Intelligence in Children.* Translated by Elizabeth S. Kite. Baltimore, Md.: The Williams & Wilkins Company, 1916. Pp. 336.

> It seems to us that in intelligence there is a fundamental faculty, the alteration or the lack of which is of the utmost importance for practical life. This faculty is judgment, otherwise called good sense, practical sense, initiative, the faculty of adapting one's self to circumstances. To judge well, to comprehend well, to reason well, these are the essential activities of intelligence. A person may be a moron or an imbecile if he is lacking in judgment; but with good judgment he can never be either. Indeed the rest of the intellectual faculties seem of little importance in comparison with judgment. . . .
>
> The same remark holds good for the study of the memory. At first glance, memory being a psychological phenomenon of capital importance, one would be tempted to give it a very conspicuous part in an examination of intelligence. But memory is distinct from and independent of judgment. One may have good sense and lack memory. The reverse is also common. Just at the present time we are observing a backward girl who is developing before our astonished eyes a memory very much greater than our own. We have measured that memory and we are not deceived regarding it. Nevertheless that girl presents a most beautifully classic type of imbecility.
>
> As a result of all this investigation, in the scale which we present we accord the first place to judgment; that which is of importance to us is not certain errors which the subject commits, but absurd errors, which prove that he lacks judgment. (pp. 42–43.)

It would appear that Binet in his emphasis upon judgment as the *sine qua non* of intelligence was coming close to the old Anglo-Saxon term, *gumption.*

In the same work, Binet and Simon attempted to make a distinction between intelligence and scholastic aptitude. However, their term *scholastic aptitude* in present-day terminology would become *scholastic achievement,* for it is derived from "degree of culture," and "amount of instruction." Nevertheless they tried to make a distinction between school abilities and intelligence:

> A child, even if intelligent, will learn little in class if he never listens, if he spends his time in playing tricks, in giggling, in playing truant. The lack of attention, of character, of will, do not appear or scarcely so, in our tests of intelligence, the test is too short; the pupil is not left to himself sufficiently. In fact, in our examinations we have not found an inattentive child except among those of three or four years. All make a good effort; they are near us and our presence alone is sufficient to prevent a weakening of attention. It is not under such conditions that one can measure the ordinary power of attention of a child; it is when he is left to himself. (p. 254.)

This would appear to be not inconsistent with the present position that application and attention (the attribute we have called *concentration*), if they can be measured in relation to the performance of intellectual tasks, should be allowed to enter into the mental rating. Binet and Simon simply point out that the tests as constructed have not permitted this distinction. But it did not occur to them that the same habits that interfered with schoolwork would modify school-type work, even when the latter was designated "intelligence test."

Stern,[1] who is generally regarded as the original sponsor of the IQ concept, has indicated his reasoning about it, as follows:

> Binet used as the measure of retardation simply the difference between mental age and chronological age and was so convinced of the general application of this measure that he looked upon the value "2 years" as a general expression for a definite and in fact serious deficiency.
>
> Binet's successors also made use of this standard, but their own results teach us that we can not be satisfied with it. For it has become evident that *one and the same absolute difference, e.g., a mental retardation of three years, means very different things at different years. . . .*
>
> That the size of the absolute difference for the same degree of feeble-mindedness should increase as age increases is psychologically easily intelligible, for, since feeble-mindedness consists essentially in a condition of development that is below the normal condition, the *rate* of development will also be a slower one, and thus every added year of age must magnify the difference in question, at least as long as there is present anything that could be called mental development at all. With this in mind it is but a step to the idea of measuring the backwardness by the relative difference, i.e., by the ratio between mental and chronological age, instead of by the absolute difference. Bobertag had already conceived a plan of this sort, while Kramer hints at something of the sort, though very guardedly: "Whether perhaps there might be devised a specific method of calculation for relating the difference in years to chronological age and which would then give us an absolute measure for degree of feeble-mindedness, seems to me a matter of doubt.". . .
>
> I should like to recommend the relating to chronological age not of the difference, but of the mental age itself. We would then obtain the *mental quotient* that has already been mentioned. *This quotient shows what fractional part of the intelligence normal to his age a feeble-*

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[1] Stern, William: *The Psychological Methods of Testing Intelligence.* Translated by Guy M. Whipple. Baltimore, Md.: Warwick & York, 1914. Pp. vii, 160.

> *minded child attains. Mental quotient = mental age ÷ chronological age.* An 8-year-old child with a mental age of six has, then, a mental quotient of $\frac{6}{8}$ = 0.75. A 12-year-old child with a mental age of 9 has the same mental quotient. (pp. 76, 79, 80.)

That a flood tide of determinism and confusion was released by Stern's innocent arithmetical fraction is one of our major themes

CHAPTER IV

TRANSLATIONS AND REVISIONS OF BINET TESTS

THE STANFORD REVISIONS

In 1916, Terman's Stanford Revision of the Binet-Simon Scale[1] offered a translation, refinement, and extension of the original Binet materials. No new principles were introduced, although the testing procedure from the start involved utilization of Stern's mental or intelligence quotient. The plan was to arrange the tests so that for a general population of children the median mental age would equal the median chronological age. Thus the mental age at ten would be taken as the average mental rating of unselected ten-year-olds, and so on for the various ages from three to adulthood. The subjects available, about one thousand in number, were measured within two months of their birthdays. Many new items were added to the original Binet items in the preliminary tryouts. To be retained, an item had to show an increase in the percentage of children passing it with increasing chronological age. Once a rough validity had been established, the scale was self-validated by finding the difference in percentage passing for three groups separated on the basis of a preliminary intelligence quotient. It was considered important to have each item consistent with the whole test, and, in general, with school progress and subjective estimates of mental ability. For example, the tests at the older ranges were expected to give a higher percentage of passing for professional persons than for persons at lower socioeconomic levels.

For American children and for a better sampling than that utilized by Binet, there were indicated substantial shifts in the placing of items. Binet's validation resulted in the scale being too easy in the lower chronological ranges. Also the tests struck a ceiling rather sharply for bright children in their teens and for many adults. Since it was clear that there was not enough "top" to the mental ages to lend credence to the later IQ's, the device was hit upon of using a chronological age divisor of 16 for all persons beyond that age. (There was a tendency subsequently on the part of clinical psychologists to push this divisor down to 15 or even 14.) Certainly bright children, that is, those with high intelligence quotients, could not stay very bright as they moved beyond chronological age sixteen. A child of seven could secure an IQ of 150 by passing all the tests up through fourteen years, or their equivalent, but at age sixteen this would have required tests extending through age twenty-four. In 1916 (as in 1937) such materials were not made available. For these later ages, one could postulate (*a*) a deceleration in mental growth, (*b*) an inadequacy of test materials, or (*c*) a combination of the two. Since there were no fixed points in this choice, it became common practice to accept option (*c*), for there was early evidence that mental growth did not really cease in the late teens. Hence, for average or above-average subjects, the later mental ages became progressively too low.

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[1] Terman, Lewis M.: *The Measurement of Intelligence: An Explanation of and a Complete Guide for the Use of the Stanford Revision and Extension of the Binet-Simon Intelligence Scale*. Boston, Mass.; Houghton Mifflin Company, 1916. Pp. xviii, 362.

In this chapter and elsewhere there will be included various criticisms of Binet testing, with special reference to the Stanford revisions. However, the main purpose is not to undertake a critical analysis of these tests as such, but to show the origin and development of concepts in mental testing in order to throw light on the meaning of intelligence. When such terms as *intelligence*, *mental age*, and *intelligence quotient* are used with respect to children in American schools, clinics, courts, and institutions, more often than not it will be one of the Stanford revisions that has furnished both the concept and the measurement. While little theory is contained in them beyond Binet's original formulations, they have been the subject of an enormous amount of speculation which has sought to establish both their practical usefulness and their psychological implications.

Wallin [1] may be quoted as a typical commentator with wide clinical experience:

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[1] Wallin, J. E. W.: The Results of Multiple Binet Retestings of the Same Subjects: The Educational Implications of Variation of Test Performance. *Journal of Genetic Psychology*, 1940, 57, 345–391.

> Let us remind ourselves that the Stanford-Binet scale contains not only so-called power tests, but also tests of information or erudition the successful performance of which is dependent solely or largely upon experience or learning. It is obvious therefore that the results of instruction will be reflected in Binet performance. (p. 380.)

The 1937 Stanford-Binet tests offer certain refinements and extensions. The new tests in two forms, L and M, go down to year two, and they provide materials designated "Average Adult" and "Superior Adult I, II, and III." A full account of the standardization of these tests is contained in Terman and Merrill.[1] The two sets of materials measure roughly the same functions, with an expected correlation, for the range of talent commonly found in an elementary-school grade, in the low .90's. There is again a heavy dependence on the increase in per cent passing the items and on the desirability of getting samplings of unselected children to score mentally at age. The final age placement was made on a new population of unselected children. For the per cent passing each item, for all the children in the sampling, there was substituted a discrimination quotient based on the difference between the ages of the subjects passing a test and those failing it. Terman and Merrill state that the purpose of the revision was to provide scales closely comparable to the first revision with respect to the mental abilities tested. There is a further expectation that mental ages will correlate well with school marks in abstract subject matter.

In the number of tests, the scales have gone from the 58 available in Binet, to 90 in the 1916 revision, to 129 in each of forms L and M. While there has been some further attention paid to the question of verbal emphasis, it is doubtful if this has been reduced markedly, although it is less noticeable for certain ages. It is now possible for adults to secure higher IQ's and for bright children to have contact with a wider range of testing. A principal scoring change has been brought about through a new method of computing the chronological age. Between ages thirteen and sixteen, the chronological age is taken to mean thirteen years plus two-thirds of the additional age, but no chronological age is assigned to exceed sixteen. This is simply an empirical device to prevent a rapid declination in the intelligence quotient.

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[1] Terman, Lewis M., and Merrill, Maud A.: *Measuring Intelligence: A Guide to the Administration of the New Revised Stanford-Binet Tests of Intelligence.* Boston, Mass.: Houghton Mifflin Company, 1937. Pp. xi, 460.

To obtain a representative sampling there were mobilized about three thousand subjects aged two to eighteen, selected in seventeen communities in eleven states, with later adjustments for securing a better representation of the rural groups. In view of the large number of testings at year and half-year intervals, the final sampling for each chronological age was of the order of one hundred to two hundred children. The subjects were confined to American-born white children.

Again a final age arrangement was based on an attempt to make the mean mental age for each subsampling equal to the mean chronological age. This was done separately for the two sexes, eliminating items that tended to show sex distinctions. Items were selected not only in terms of an increase in the percentage passing over some acceptable age range and with a slope considered steep enough to indicate discrimination, but in relation to such miscellaneous criteria as ease of scoring, appeal to the subject, time requirements, and convenience of administration. Each test was expected to show substantial correlation with the composite total score. There is no account of how much weight all these statistical and empirical factors might have had in the final selection and placement of a test.

It may be said that the final outcome, so far as type of material is concerned, is not much different from the 1911 Binet scale. In both instances we find tests of opposites, comprehension, vocabulary, similarities and differences, completion, absurdities, and memory. Both before and after administering the test we get the impression not so much of carelessness or inadequacy as of a definitely opportunistic approach to test standardization. Whatever definition of intelligence was involved (Terman in 1916 called it "the ability to do abstract thinking"), it is clear that no definition or theoretical statement was allowed to carry much weight.

Since the new Stanford Revision was long-promised and long-awaited, the comments and experiences of a few well-known workers may not be out of place. Burt,[1] in England, had this to say:

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[1] Burt, Cyril: The Latest Revision of the Binet Intelligence Tests. *Eugenics Review*, 1939, 30, 255–260.

> With an externally graded scale, like the Binet-Simon series, everything turns upon the relative difficulty of the test-problems. The standardization of each problem in terms of a mental age assumes that the order of difficulty is constant for the two sexes, for different social classes, for different ages, for different types of child, and above all for different localities. Thus, if a child repeats four numbers backwards, Terman would give him a mental age of 9; if he repeats six numbers forwards, i.e. in the order in which they have been recited to him, he would get a mental age of 10. Now with London children it is found that the latter test is actually easier than the former. And so with many other tests: the order of difficulty is often reversed. Worse still, when we experiment with the scale as a whole, there seems to be no fixed order at all: what is easier for one child may be harder for another. (p. 257.)

Burt believes that, while the Binet and the first Stanford Revision were overweighted with verbal tests, the new revision is "overweighted with practical or manual tests."

Krugman,[1] chief psychologist at the Bureau of Child Guidance of the Board of Education, New York City, states that the general reaction of clinicians to the new revision was one of "almost complete disappointment."

Difficulties in scoring or interpretation were found in the following tests: Picture Absurdities (VII, 1; X, 2); Reasons (X, 4); Abstract Words (XII, 5; XIV, 6); Proverbs (A. A., 5; S. A. II, 4); Reconciliation of Opposites (A. A., 8); Essential Similarities (S. A. I, 6); Verbal Absurdities (all levels); Picture Interpretation (XII, 3); Reasons Test (X, 4); Problem Situation (XI, 5); Vocabulary (roar, puddle, muzzle); Paper Cutting (IX, 1). Krugman reports that the psychologists listed no less than twenty-five items as misplaced, the material being scattered from year IV to Superior Adult II. In the second part of the study he reports, on the basis of 1,002 Revised L examinations, that from 15 to 20 per cent of the children showed more than one basal or final year. Sometimes this has an important effect upon the obtained IQ.

On the basis of 403 cases constituting a random sampling of school populations in grades 1, 2, and 3, Krugman, with Form L, found a close approximation to a normal distribution. This would indicate that the new scale is genuinely improved at these levels. Krugman's general conclusion is this:

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[1] Krugman, Morris: Some Impressions of the Revised Stanford-Binet Scale. *Journal of Educational Psychology*, 1939, 30, 594–603.

> Form L of the new scale seems to be a better constructed instrument, much superior to the old for survey purposes, and possibly even for clinical purposes, but with many shortcomings which, if corrected, would make it much more satisfactory for clinic use. (p. 603.)

For adults, the new scale shows wide departures from the old. As Mitchell[1] says, "Physicians long accustomed to relatively low I.Q.'s for their patients have been perplexed, to say the least, when receiving reports of I.Q.'s in the 130's and 140's." (p. 516.)

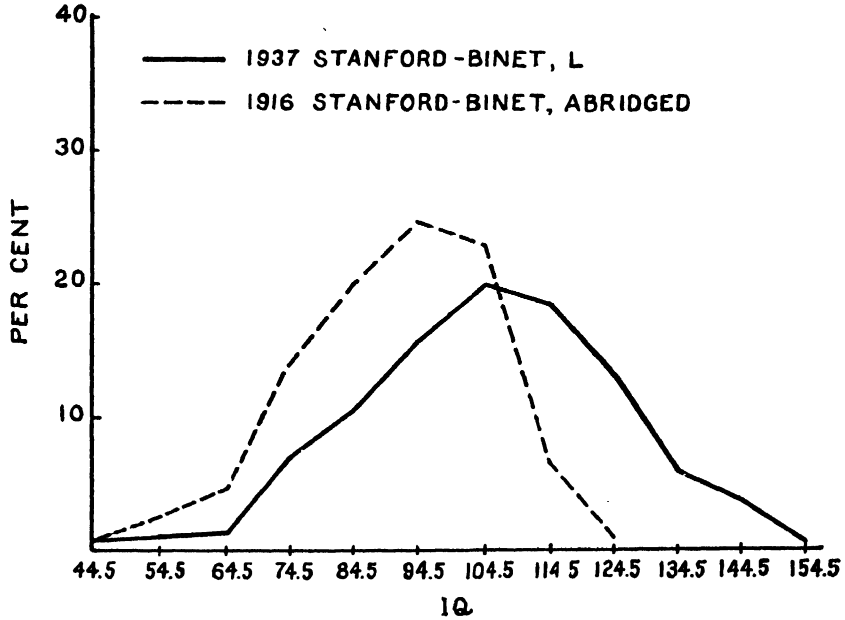

FIG. 1. IQ's of Patients in a Psychopathic Hospital. (From Mitchell, p. 517.)

It will be recalled that the maximum IQ for adults on the 1916 revision was 122. On the basis of testing 155 patients in the Psychopathic Hospital of the University of Iowa, she obtained the graph above. The average IQ's were, respectively, 91 and 105. The two tests correlated $r = .92$. When the sampling was classified in relation to education (grade-school, high-school, or college attendance), the mean IQ increases were, respectively, 9, 15, and 19 points. A group of eighty-seven senior medical students in the university obtained a mean score of 110 on the 1916 scale and 131 on the 1937. For these selected students, the two scales correlated only to the extent of $r = .73$. Hence we are left again with the question, What does the IQ signify in either case?

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[1] Mitchell, Mildred B.: The Revised Stanford-Binet for Adults. *Journal of Educational Research,* 1940–1941, 34, 516–521.

The following tabulation from Merrill[1] indicates the shifting that has occurred as between the old and new Stanford revisions.

Percentile	*IQ Old Scale*	*IQ Revised Scale*
99	130	143
98	128	138
97	125	134
95	122	131
90	116	124
85	113	121
80	110	117
75	108	114
66.6	106	111
33.3	95	96
25	92	93
20	91	90
15	88	87
10	85	83
5	78	77
3	76	73
2	73	70
1	70	65
N	905	2,904

It will be seen that high IQ's (SR) are higher in the new scales (L–M), and that the lower IQ's may be slightly reduced. Merrill also presents data on 1,517 children reexamined in the elementary schools of Kansas City who had been examined with both the Stanford Revision and the new scale at average intervals of from three to five years, in the chronological age range from five to eleven. (The cases showed a pile-up of school problems.) There was a slight tendency for the revised scale to show lower IQ's, the differences in mean performance being significant at ages five, six, and eleven. Correlations between the IQ (SR) and the IQ (Form L) centered in the middle .70's.

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[1] Merrill, Maud A.: The Significance of IQ's on the Revised Stanford-Binet Scales. *Journal of Educational Psychology*, 1938, 29, 641–651.

The long-continued emphasis on rapport characteristic of Binet, Terman, and Terman and Merrill indicates what can happen when rapport is not well established, for example, when the examiner is inexperienced or the subject shows fatigue or an emotional state. Since all such influences are likely to be downward, we might consider using the highest rating attained. It is not a simple case of reaching a fixed standard of rapport. It may be that the subject is always fatigued, emotional, or confused by oral directions. In this case what seems to be poor rapport is a chronic condition of the organism with respect to mental demands. Rapport is well established when the dynamics of the testing situation closely parallel the general conditions under which mental demands will be made upon the subject. In a world of constant noise it may be misleading to measure subjects in a soundproof room; in a world conducive to emotional upset, testing need not be saintly.

It is well known that the age-grade method of validation produces coarse units. Moreover, for reasons not clear to the users of tests, there has long been a withholding of useful data that must have been gathered in the course of standardization. This was particularly true of the 1916 Stanford Revision of the Binet-Simon Scale. This revision was accepted on faith. For two decades it was the mainstay of individual mental testing. After a few years certain defects became obvious, such as the weakness of the scale at the upper and lower levels. But the nature of the technical investment was such as to block any early systematic revisions. In the words of Grace H. Kent:[1]

> Within the year-scale system, the subject matter of the Stanford-Binet scale is used with unnecessary wastefulness. When a child responds correctly to only three of the five absurdity questions, he of course fails to achieve ten-year credit on that item; but might he not be given nine-year credit for three acceptable responses, and possibly eight-year credit for two responses? We who have not had access to the sources do not know the mental-age value of anything less than four responses, but the test could hardly have been stand-

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[1] Kent, Grace H.: Suggestions for the Next Revision of the Binet-Simon Scale. *Psychological Record*, 1937, 1, 409–433.

> ardized without establishing such values for one, two and three responses. Why should we be denied the use of these additional values? (p. 411.)

Kent feels that the raw materials of the 1937 revision are good, but that, from the clinician's viewpoint, they are still presented in a rigid and wasteful manner.

Inasmuch as an age-scale places much weight upon each test-item and some types of items, such as vocabulary or memory for digits, are recurrent, a child's "intelligence" is responsive to the pattern that is actually represented in the test. For example, what proportion of mental testing should be given over to a survey of the knowledge already possessed by the child, as in general information and vocabulary? How many tests should be devoted to a recasting of skills for the purposes at hand? Thus in arranging five weights successfully, the child has to arrive at a mental solution; the essence of the test is not in his ability to discriminate weights but to set up a methodology. Possibly he has done this previously, but the situation is new. The tests for repeating digits date from the Binet 1908 list. The particular order of digits has not been memorized, nor is it likely that children have practiced memorizing digits backwards. It is essentially a new task based on old abilities. It would be possible to ask all children to do only things that they had never done before. This would rule out some of the best tests, such as definitions and vocabulary. The child learns no new words during the course of the mental testing, even though he may be stimulated to produce definitions. Whatever he produces he had within him. The tester does not test, under supervised conditions, his ability to take on new learning at the moment.

THE VOCABULARY TEST

The direct contribution of vocabulary in intelligence testing is derived from the child's growing knowledge of an acceptable verbal definition of fifty (or one hundred) words presented in ascending order of difficulty. Such responses are likely to be in terms of the commonest meanings of the words presented. Recently, Lovell[1] has asked whether this commonest meaning is related to a knowledge of multiple meanings and to refined word discriminations. Utilizing the samplings prepared by Seashore and Eckerson[1] which were based on an unabridged dictionary, he obtained correlations in the .50's (for small samplings of college students) between the ability to give the commonest meanings and to give multiple meanings. Improvement in the use of vocabulary scales in intelligence testing may depend primarily on getting a better sampling of words.

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[1] Lovell, George D.: Interrelations of Vocabulary Skills: Commonest Versus Multiple Meanings. *Journal of Educational Psychology*, 1941, 32, 67–72.

The work of Seashore [2] has shown that estimates of the complete vocabulary of children and adults have in the past been far too low. The spread of literacy and of public education at all levels, the increasing dependence of social groups on publications, talking pictures, and radio, and a vast interest in technology and geography — all these are factors in strengthening the position of language as a common vehicle for the development of thought.

Terman's view of the value of a vocabulary test in the measurement of intelligence is as follows:[3]

> The vocabulary test has a far higher value than any other single test of the scale. Used with children of English-speaking parents (with children whose home language is not English it is of course unreliable), it probably has a higher value than any three other tests in the scale. Our statistics show that in a large majority of cases the vocabulary test alone will give us an intelligence quotient within 10 per cent of that secured by the entire scale. Out of hundreds of English-speaking children we have not found one testing significantly above age who had a significantly low vocabulary; and correspondingly, those who test much below age never have a high vocabulary. (p. 230.)

Recently Terman and Merrill [4] sustain this position:

> We have found the vocabulary test to be the most valuable single test in the scale. Its interest value is high, it presents a familiar task to the subject, and the fact that it begins with words in common

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[1] Seashore, Robert H., and Eckerson, Lois D.: The Measurement of Individual Differences in General English Vocabularies. *Journal of Educational Psychology*, 1940, 31, 14–38.

[2] *Ibid.*

[3] Terman, Lewis M.: *The Measurement of Intelligence: An Explanation of and a Complete Guide for the Use of the Stanford Revision and Extension of the Binet-Simon Intelligence Scale.* Boston, Mass.: Houghton Mifflin Company, 1916. Pp. xviii, 362.

[4] Terman, Lewis M., and Merrill, Maud A.: *Measuring Intelligence: A Guide to the Administration of the New Revised Stanford-Binet Tests of Intelligence.* Boston, Mass.: Houghton Mifflin Company, 1937. Pp. xi, 460.

> use and increases rapidly in difficulty gives the examiner a rapid survey method of estimating the subject's ability. It agrees to a high degree with the mental age rating on the scale as a whole; correlations for single age groups range from .65 to .91 with an average of .81. (p. 302.)

Yet, both theoretically and practically, something is wrong, for in the same book Terman and Merrill report:

> Miss Green reports in her study the results of the vocabulary test for a group of 100 adults ranging in age from 19 to 84. Care was taken to secure a representative sampling according to economic and social status. Her investigation indicates that there is no great change in this ability after maturity is reached. The correlation between age and vocabulary score was found to be .09. Several other studies have shown that vocabulary remains practically unimpaired to extreme old age. (p. 303.)

This reaches a logical impasse, as follows:

(1) The best single measure of intelligence is vocabulary;
(2) Intelligence, as measured by a complete scale or battery, does not grow much after the late teens, and in later years declines;
(3) The best measure of intelligence does not decline.

The vocabulary of children, even the poor measurement of it available in the Stanford revisions, is an indicator of the ongoing learning of the child; it is not a set of connections long ago established and placed on tap. For the old person, a knowledge of basic vocabulary is more like his residual skills in swimming, bicycling, golf, or tennis. While the factor of retention may be high, the old person's ability to take on new learning is sharply decreased. This leads to the premise that there should be in mental testing a much greater weight upon the ability to learn new things, upon plasticity and originality. It should be feasible to point an enriched vocabulary test in that direction.

The speed and accuracy with which a child acquires vocabulary and his ability to articulate it with past learning are not sufficiently exploited. Under widely differing cultural conditions, with impingements running from infancy to senescence, an extended vocabulary test could furnish a chart of mental fluctuation and growth. Some mental testers who accept vocabulary as an integral part of intelligent behavior, provided the knowledge has been gleaned slowly and opportunistically, would be loath to grant its validity under really good conditions of stimulation and guidance. So far there is no satisfactory answer to the question, Which is the better measure of intelligence over a period of a year — the child's vocabulary at the first testing, or the number of words gained during the year? We have in vocabulary:

(1) A measure which is regarded as an essential ingredient of intelligence at all ages from one year up.
(2) A measure easily and reliably obtained.
(3) A function that improves with successive age groupings.

If all the statements above are true, why should we hold that a person's intelligence ceases to grow at any given age? Would it not be sounder to say that the adult increases his intelligence up to the point where he no longer increases his vocabulary?

Whether or not the Stanford Revision and other tests like it are too verbal cannot be judged simply by counting and classifying. Nor can corrections be made for excess verbalism by estimating what children would do on the nonverbal parts of the scale. A child who has reading difficulties would do better if the tests of vocabulary and sentence structure were eliminated, but to eliminate the tests for that reason would damage the total validity of the scale. Presumably verbal tests are utilized in intelligence testing because they best carry the weight of the attributes or factors in a given definition. If all abstraction were verbal then all mental testing would be verbal. It is only when the attributes are lost sight of, or badly weighted, that we seek other methods and materials of testing. Since oral or written instructions are common, we may be sure that practically all standard tests carry a heavy verbal saturation. In view of the nature of thinking in relation to problems (including those with physical, motor, or social origins), we need not be concerned about the gross appearances of tests. Rather we should devote our techniques toward closing the gap between what we regard as intelligent behavior and what is actually measured under given conditions.

No emphasis on vocabulary should deceive us about the fatuousness of the "information please" type of learning. This is unrelated to intelligence except that (*a*) a memory factor is implied, (*b*) the persons employing it commercially are intelligent to the extent that they have estimated correctly people's interests, and (*c*) it is a kind of game, like chess, that is more likely to be taken up by intelligent persons. At the elementary levels, these know-it-all skills have an ingredient of intelligence. Carried beyond that, they become something else, and may be deleterious. The real test is not in the ability to answer superficial questions in a large number of areas, but to answer the second, third, and fourth questions in a systematic hierarchy — the problems of the scientist, the scholar, the artist that dig in, as it were, and take root.

This brings us to a major defect in present-day testing — it is unable to get below the surface of the mind. It measures what a child knows rather than how far he can go in the pursuit and discovery of ideas. It has almost no bearing on originality, on the mobilization of many ideas toward a single concept, or on the ability to devote his attention over a period of time to a single line of thought. A smattering of knowledge in many fields will lead to a score equal to that of the child who could do marvelously well along certain lines, but whose accredited performance is cut off far below his mental limits. For example, the child with a 30,000-word vocabulary can scarcely get more mental credit than a child with a 10,000-word vocabulary, although the differences in mental accomplishment are tremendous.

WHAT MENTAL TESTS MEASURE

In 1916, there was not full agreement that abstract processes had a place in intelligence testing, for Terman remarked:[1]

> A few critics have objected to the use of tests demanding abstract thinking, on the ground that abstract thought is a very special aspect of intelligence and that facility in it depends almost entirely on occupational habits and the accidents of education. Some have even gone so far as to say that we are not justified, on the basis of any number of such tests, in pronouncing a subject backward or defective. It is supposed that a subject who has no capacity in the use of abstract ideas may nevertheless have excellent intelligence "along other lines." In such cases, it is said, we should not penalize the subject for his failures in handling abstractions, but substitute, instead, tests requiring motor coördination and the manipulation

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[1] Terman, Lewis M.: *The Measurement of Intelligence. An Explanation of and a Complete Guide for the Use of the Stanford Revision and Extension of the Binet-Simon Intelligence Scale.* Boston, Mass.: Houghton Mifflin Company, 1916. Pp. xviii, 362.

> of things, tests in which the supposedly dull child often succeeds fairly well.
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> From the psychological point of view, such a proposal is naïvely unpsychological. It is in the very essence of the higher thought processes to be conceptual and abstract. What the above proposal amounts to is, that if the subject is not capable of the more complex and strictly human type of thinking, we should ignore this fact and estimate his intelligence entirely on the ability he displays to carry on mental operations of a more simple and primitive kind. (p. 344.)

The quotation above has special reference to the test for superior adults that requires a repetition of the thought of a passage. Terman goes on to say: "The worst fault of the test is its susceptibility to the influence of schooling." (p. 345.) *This gives us in capsule form the intellectual blocking that has afflicted mental testing for a quarter century.* The inconsistent pattern can be presented as follows:

(1) Abstraction is a necessary attribute of intelligence.
(2) Tests of ability to do abstract thinking are rightly included in intelligence scales.
(3) The ability to deal with abstractions improves with schooling.
(4) Since schooling makes a difference, the test item is defective — the place of abstraction in a concept of intelligence becomes dubious.

By this devious route, resembling the ancient analysis of the movement of the sun around the earth, one is brought eventually into a cul-de-sac: the admittedly best tests, such as vocabulary, general information, and abstractions, are all "under the influence"!

There is probably a general agreement among technical workers that the 1937 Stanford Revision measures essentially *scholastic aptitude.* Some say that it measures scholastic experience, but they go too far. Differentials of schooling, as in reading opportunity, will have an effect upon the scores, but schooling would not in itself account for the variations in ability that are found. The test approaches a rating of intelligence under school and clinical conditions, but it does not justify the expression "the intelligence of the child is thus and so." Now, as before, in order to render its ratings reasonable and practical, Binet testing needs reenforcement through measures of aptitude, experience, and achievement, together with firsthand clinical observations of behavior. As a contribution to theory, the new Stanford Revision must be regarded as having negligible value.

Perhaps the considered judgment of Wells,[1] an experienced clinical psychologist, will afford a summary of present-day reactions to the latest Binet test:

> In general the [1937 Stanford-Binet] scale ascends in merit as it approaches the earlier years. The contribution at the adult levels is doubtful, at grade school levels it is good of its kind; at preschool levels very good, save for the weakness inherent in Binet systems generally, lack of functional organization. They represent an embryonic, undifferentiated, mass reaction phase in psychometric development. . . . A considerable regret from the clinician's standpoint must still be that the series is so detached from events in the field of applied mental measurement during the past twenty years. The generously spent resources would have made a much more valuable contribution through a series of subtests, each strong enough to stand alone, fairly balanced among verbal and nonverbal functions, extending from early levels to something like average adult. The *Kuhlmann-Anderson Series*, the *Minnesota Preschool Scale*, and other studies, such as those of David Wechsler, and the *Detroit Learning Aptitude Series*, have been pointing the way. The present writer recalls making an allied suggestion to Terman himself, at the end of 1923. With all sympathy for the sentiment that impels one to rebuild and refurnish an old faithful of a Model T, the more practical recourse is generally to a later machine. (pp. 113–114.)

Wells' comment on the relative success of the preschool age ranges is of especial interest. According to Terman and Merrill,[2]

> The difference between one-year and two-year intelligence is far greater than that which separates the average fifteen-year-old from the average sixteen-year-old. The former difference is so large that it is obvious to anyone, the latter so small that it is rarely detectable by the most elaborate mental tests. (pp. 25–26.)

This statement is remarkable in view of the long failure to extend the tests downward into the early preschool years. That measurable mental differences exist at these young ages follows less from the work on the Stanford revisions than from the efforts of Kuhlmann, Baldwin, Descoeudres, Gesell, Shirley, Stutsman, Bayley, Fillmore, and others. How large these differences are and how they compare with differences at the later ages cannot be determined from the Stanford revisions.

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[1] Wells, F. L.: Revised Stanford-Binet Scale. [In] Buros, Oscar Krisen [Editor]: *The Nineteen Thirty-Eight Mental Measurements Yearbook of the School of Education, Rutgers University.* New Brunswick, N J.: Rutgers University Press, 1938. Pp. 415. (pp. 113–114.)

[2] Terman, Lewis M., and Merrill, Maud A.: *Measuring Intelligence: A Guide to the Administration of the New Revised Stanford-Binet Tests of Intelligence.* Boston, Mass.: Houghton Mifflin Company, 1937. Pp. xi, 460.

The method of counting mental age introduces a progressive stabilizing factor in terms of the area common to two or more determinations. Practically all the tests available to the sixteen-year-old were already given to him as a fifteen-year-old. The progress, in psychological terms, from one year to the next is masked by the scoring procedures. No tests at all are provided for areas within the higher ranges of the attributes of intelligence. The offerings are largely "more of the same," such that the tests for superior adults are close in form and substance to those for the preschool child.

While intelligence is related to neural function, Binet subtests themselves are not organically meaningful. Are they meaningful in terms of a diagnostic map or mental pattern, or as a good prognosis of further development? What does a Binet subtest represent that is different from any other subtest? It is simply a task that seems to be "mental" within a certain range of child development — a task that yields a reasonably sharp increase in the percentage passing as we go up the chronological age scale. Theoretically these increments could be provided in a single complex function such as vocabulary or reading comprehension.

It is likely that centile scores, in spite of the reduction of base-line length near the mean and elongation at the extremes, would be more helpful than mental ages and IQ's in school and clinic situations. Sigma scores or T-scores, similarly based on points, would be helpful. These methods of scoring would encourage the development of tests available for long age ranges — for example, a vocabulary test for ages two to seventy. Point scoring should reduce the fanatic attachment that some persons have for a fixed quantity that can be predicted, subsidized, and inherited — the modest virtues of the IQ!

In the 1940 and 1941 meetings of the American Psychological Association, Growdon[1, 2] maintained that the new Stanford

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[1] Growdon, C. H.: Is the Revised Stanford-Binet Scale Really an Age Scale? *Psychological Bulletin*, 1940, 37, 512.

[2] Growdon, C. H.: The Revised Stanford-Binet Scale Viewed as a Point Scale. *Psychological Bulletin*, 1941, 38, 593–594.

Revision is more efficient as a point-scale than as an age-grade scale. With some relocation of the items in Form L and on the basis of 440 children eight to eighteen years of age, "the findings indicate a saving of approximately one-third of the time required in testing, a material reduction in scatter, and a final rating which is very close to that of the original scale. The correlation between the IQ ratings by the use of the point-scale and those obtained by the standard method of Form L is .97 with a P.E. of .002." (pp. 593–594.) If Growdon's work is sustained, there may well be among clinical psychologists a mighty communal sigh over the millions of man-hours wasted during the last quarter century, and a resolve henceforth to insist upon test-economy!

Wallin[1] observes:

> The most recent criticisms by the Iowa Child Welfare Research Station workers are as challenging as any that have been leveled against the [Binet] scale during its entire history, although the assault on the scale itself is implicit rather than direct and perhaps less affects its fundamental structure than the uses made of its results as well as of the results of other tests of ability. These investigators' "pessimistic commentary on the value of intelligence tests" seems to lead inescapably to the conclusion that a Binet IQ affords a reliable measure of intelligence only at the time the test is given and possesses no prognostic value as a measure of inherent or constitutional endowment. It affords a measure of environmental stimulation rather than of native ability. (p. 347.)

The Iowa workers would regard Wallin's paragraph as somewhat complicated; they feel that, over the years, the Stanford revisions have offered not very reliable measurements of functions not very close to intelligence. The statement implies that a mental test could separate components of heredity from those of environmental stimulation and opportunity. No Binet test could throw much light on this question. What could be learned and what is learned are inextricably combined: not environmental stimulation as against native ability, but a coupling of the two sets of factors without differential analysis. Since this merging will always characterize the individual child, the extent of individual differences ascribable either to nature or to nurture could be approached only in terms of variations in populations. A child may "inherit" a weak physical structure, but by an extraordinary concomitance of nutrition and exercise surpass all expected standards. The conditions that underlie the suppression or expansion of incipient organic responses issuing into genuine behavior differentials designated *intelligent* elude the available tests.

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[1] Wallin, J. E. W.: The Results of Multiple Binet Retestings of the Same Subjects: The Educational Implications of Variation of Test Performance. *Journal of Genetic Psychology*, 1940, 57, 345–391.

VARIABILITY IN IQ

Wechsler's analysis[1] of the Terman and Merrill data on reliability in Stanford-Binet is revealing. To quote:

> More direct evidence of variability of I.Q. with age is furnished by the statistics of Terman and Merrill in their new revision of the Stanford-Binet. Their tables (T & M, pp. 36–40) are worth examining in detail. They contain some very significant surprises. In the first place, even the mean I.Q.'s show great variability, differing by as much as 9 per cent at different ages; for example, from a mean I.Q. of 109.9 at age 2½ to a mean I.Q. of 100.9 at age 14. But even more significant are the differences between the Standard Deviation of the means at different age levels. These differ by as much as 7.5 units, and in consequence give rise to significant deviations from the I.Q. expectancy. Thus, the standard deviation for the mean I.Q. at age 12 on the Revised Stanford-Binet (Form L), is 20.0, and at age 6, only 12.5. Accordingly, depending upon the age at which an individual is being tested, he may obtain different I.Q.'s even though his relative brightness remains unchanged. Thus, supposing him to be an individual whose position is 2 standard deviations from the mean, he would get at age 6 an I.Q. of 75 and at age 12 an I.Q. of 60. This would imply that an I.Q. of 60 at age 12 means the same as an I.Q. of 75 at year 6. (p. 27.)

In short, IQ's obtained over an age range may be different one from another, even though the numerical computation yields the same figure; conversely they may be the same, even though the computed IQ's are different. Similarly Kuhlmann's experience[2] led him to regard the IQ as inconstant.

THE KUHLMANN REVISIONS

For his own tests of mental ability Kuhlmann[3] drew from various sources. For the most part they have been common property in the testing field since the days of Binet. In the earlier age ranges Gesell was drawn upon. Kuhlmann judged the merits of each subtest in terms of the increase in raw score and per cent of children passing with advancing chronological age, and of the correlation obtained with the total score. Kuhlmann's test is for ages four months and over, the subtests being arranged in order of difficulty. The scores are based on the Heinis Personal Constant which Kuhlmann calls Percent of Average. F. L. Wells[1] has reviewed this test:

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[1] *Op. cit.*

[2] Kuhlmann, F.: *Tests of Mental Development: A Complete Scale for Individual Examination.* Minneapolis, Minn.: Educational Test Bureau, 1939. Pp. xi, 314.

[3] *Ibid.*

> [The Kuhlmann Binet] occupies a position between the Binet systems and the *Wechsler-Bellevue Intelligence Scale* and *Detroit Tests of Learning Aptitude;* on the whole nearer the Binet. The main issue is between a large number of disparate procedures, each aimed at a single or narrow range of developmental levels, and a much smaller number, each covering a considerable range of developmental levels. Kuhlmann is clearly a partisan of variety, in the Binet tradition. The background of the present writer definitely favors the other policy, as embodied originally in the performance scales, and now very effectively in the Bellevue. It is probably a matter of differential interests; Kuhlmann's being primarily in the juvenile and defective areas, the present writer's in the adult of normal or superior intellectual functions (cf., the earlier and later portions of the present scale). . . .
>
> All in all, the present offering probably represents the best instrument available over a fairly wide area, denoted as follows: (*a*) where it is desired to represent the intelligence function by a single figure; (*b*) for healthy individuals up to say fourteen years of age; and (*c*) for individuals with intelligence defect. (pp. 254, 255.)

There is a general agreement that the 1939 Kuhlmann revision is an improvement over the 1922. Kuhlmann quotes median IQ's clustering about 100 for samplings that average 105 cases per year through age five and 140 cases per year through ages six to sixteen. He believes in the efficacy of testing at preschool levels:

> There are many things which all children must learn to do while young, and have sufficient opportunity to learn and will learn if they can. All must learn to use the sense organs, and muscles, to walk, talk, feed, and clothe themselves, recognize and learn the use of things found in every household, and so on. The degree in which any child fails to acquire these things is a measure of his

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[1] Wells, F. L.: [In] Buros, Oscar Krisen [Editor]: The 1940 Mental Measurements Yearbook. Highland Park, N. J.: *The Mental Measurements Yearbook*, 1941. Pp. xxiii, 674. (pp. 254–255.)

> inability to learn. As children become older their abilities become more specialized. There remain fewer tasks for them to learn to do that are common to all, and the measurement of their mental development becomes dependent more on the other kinds of tests. (p. 30.)

Kuhlmann, in his manual, questions the need of high reliability in a test. He prefers one in which the score varies somewhat with the child's tendency to be distracted or emotionally involved.

Usually there is a desire on the part of the makers of tests to secure reliability, that is, accuracy of measurement. A spelling test is likely to be unreliable as an indicator of the complete spelling ability of a child if based on a dozen words, or on words that are bunched with respect to experience-area. Deficiencies in the test itself will contribute to variable performance on the part of the child. While the constructor of tests does everything legitimate to secure reliability, he must be careful not to pay a price in reduced validity. For example, it is easy to make up a spelling test consisting only of words that are readily spelled. When nearly everybody gets the right answers, a retesting will yield high scores. This ensures a high reliability for a poor test.

In individual testing analogous processes are discernible. Chance factors are reduced by allowing more than one trial in some of the subtests. In the repetition of digits the child needs to repeat correctly only one of three series that are presented. Such a device alone will add to the steadiness of a child's performance. However, if carried to excess, as it is when a large amount of scatter requires the giving of many tests at peripheral levels, the procedure becomes wasteful, reducing the amount of reliability obtainable within a given time limit for a given age range.

MENTAL AGE UNITS

In clinical situations, there have been numerous attempts to analyze the composite MA or IQ in terms of the way in which the mental age units were accumulated. Some children and adults show a wide scattering by beginning to fail early and extending their successes into many age levels. Others show successes sharply in a series and are cut off similarly at the other end of the scale. Thus older deteriorated or abnormal individuals are inclined to show much scatter, while children who are slow-growing are less likely to succeed in occasional advanced tests. The point is sometimes made that any person who can pass one of the higher tests, even though his total accumulation of mental age units is not greater, is superior to another person of equal IQ who is devoid of higher successes. This may be regarded as a dubious position, although of some practical interest in corroborating clinical and social observations. An individual mental test is not diagnostic in character; it does not check the parts of the running mechanism to see where defects or disorders may lie.

A succinct statement of the incompatibility of the IQ concept and present methods of mental testing is furnished by Thurstone and Thurstone:[1]

> . . . mental ages and intelligence quotients are indeterminate for the upper half of the adult population. If a person scores above the average for adults in a psychological examination, then there exists no age for which his score is the average. College students can be assumed to score above the average for the adult population of the country, and, consequently, they cannot be assigned any mental ages or intelligence quotients. This is not a debatable question. It is a question of very simple and straightforward logic.
>
> Intelligence quotients are assigned to the upper half of the adult population by changing the definition of mental age. For example, a mental age of fifteen or eighteen does not mean the average test performance of people of that age. Such mental ages are arbitrary designations of what the test author may choose to call superior adult performance.
>
> Test norms should be tabulated in terms of percentile ranks or of standard scores for a specified group. If norms were tabulated in this manner for all age groups, we could easily avoid the ambiguities and absurdities of mental ages and intelligence quotients for superior adults. A table of percentile ranks for each age group gives much more information than the mental age, even for young children. With such tables, the test performance of a child could be given an age assignment, if such age exists. The child could be given a percentile rank in comparison with any desired age group, or his performance might be compared directly with the test performances of different groups of subjects that represent different selective conditions. (pp. 2–3.)

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[1] Thurstone, L. L., and Thurstone, Thelma Gwinn: *Psychological Examinations, 1940 Norms.* American Council on Education Studies, 1941, Series V, Vol. 5, No. 3, pp. v, 41.

Kuhlmann, in a review of Freeman's revised textbook on mental tests, registers dissent from the position of many psychologists, as follows:[1]

> There are others who have forgotten the chief lesson that Binet taught, as is evidenced by the popularity of profile scoring and the volume of work on factor analysis. We believe that the practical value of the Binet and similar scales has been solely in the relatively high correlation between the objective scores they yielded and other objective facts of practical value, such as school achievement, abilities in various occupations, and living up to various social requirements, and not in the least in a knowledge of what the scale measured. Knowing what particular ability each test in a Binet scale measured would not add one bit to its practical value, unless we knew also the correlation between each particular score and some particular activity of life in which there is some interest. (p. 538.)

Perhaps the controversy may be likened to that between a good cook relying on tried-and-true recipes and the culinary expert given to exact weights and measures. At the extremes each approach has its special hazards: the one in wastefulness and opportunism, and the other in sterile manipulations.

THE PROBLEM OF PREDICTION

Rockwell's comment[2] about mental testing might well apply to the period following the first Stanford revision, the point of view that he inveighs against having come to a strange climax in the Twenty-seventh Yearbook of the National Society for the Study of Education:

> Mental testers apparently do not see the humor of the fact that they alone, of all workers in biological science, are so precise in their techniques that they can measure and find not variation but constancy within the individual. And this in spite of the fact that they measure intelligence, not directly, but indirectly, through the avenue of learning! Yet a careful examination of the way we measure learning and the criteria which we employ should compel, it would seem, skepticism that psychology, in any of its fields, is able to speak with authority in the matter of precise quantitative measurement. (p. 91.)

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[1] Kuhlmann, F.: [Review of] Freeman, Frank N.: *Mental Tests: Their History, Principles and Application.* Boston, Mass.: Houghton Mifflin Company, 1939. Pp. x, 460. *Journal of Educational Research,* 1939–1940, 33, 536–538.

[2] Rockwell, John G.: Intelligence Testing: Its Basic Assumptions and Unanswered Questions. *Educational Method,* 1939, 19, 80–92.

It is clear now, as it could have been any time in the last two decades, that the IQ of a child may show radical shifts, shifts not to be accounted for by test unreliability. (Data on this point are reserved for Parts III and IV of this volume.) Even when the IQ of a child remains the same during repeated measurements, there can be no longer a feeling of complacency. To quote Anderson:[1]

> What is it that we wish to measure? Is it present standing or the level that will be reached when development is complete? Strong arguments could be made for either position. *This paper, however, assumes that in making the best possible prediction of terminal status, we will also make the best measurement of present status, in so far as our concern is with potentiality rather than achievement.* When tests are used in clinic or court, interest is in terminal status, i.e., at the age of 9 years, we wish to forecast status at 12 or 16 years. (p. 353.)

I have already expressed an opinion on this point, as follows:

> One might ask, "terminal" at what age? Is it true that we are really trying to predict how fast the child may become man, and as man, sink into senility? Perhaps our concern is with relative achievement *at any age.* In this sense estimates of potentiality arise from successive measures rather than from long-range prediction. It would appear that achievement in the young child is as valid as achievement later on. Is not the learning of the first fifty words around the age of two as characteristic of intelligent activity as any subsequent learning?
>
> H. V. Meredith has shown that highly reliable and valid measures of standing height do not furnish a good basis of prediction through the chronological ages 11 to 18 years. According to Anderson's thesis, this would throw doubt upon the validity or usefulness of the measures at age 11. Is such a position tenable? Following Anderson's analogy, what would *true height* or *true weight* signify?
>
> To the extent that Anderson's position is defensible, revisers and makers of tests are delinquent in claiming validity for testing at any age before they have obtained a satisfactory correlation with subsequent ages. Of course, there is no good reason for stopping at age 18 or 19; one would have to ask, do these tests, say at age 18, show a good prediction of mental ability at age 50? (p. 459.)[2]

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[1] Anderson, John E.: The Limitations of Infant and Preschool Tests in the Measurement of Intelligence. *Journal of Psychology*, 1939, 8, 351–379.

[2] Stoddard, George D.: Personal Reactions of the Yearbook Committee. The Thirty-ninth Yearbook of the National Society for the Study of Education. *Intelligence: Its Nature and Nurture.* Part I. *Comparative and Critical Exposition.* Bloomington, Ill.: Public School Publishing Company, 1940. Pp. xviii, 471. (pp. 456–459.)

Anderson's position will give little satisfaction to those who have regarded IQ constancy, when found, as one of nature's beautiful, gene-controlled invariants. All we need to do is to extend slightly Anderson's discovery, for there is no evidence to indicate that the difference in content between preschool and adult tests is greater than that found in other portions of Binet scales. As I have said elsewhere:[1]

> Among the tests in the new Stanford Revision which appear in ages 2, 3, or 4, we find the identification of objects by name and by use, vocabulary tests, form-board problems and the repetition of digits, together with tests of comprehension, analogies and the performing of three commissions. When we reach the higher flights of mental maturation, as expressed in the Form L tests for superior adults, what do we find? Among other things, a vocabulary test, the repetition of digits and the understanding of analogies. It is true that a few tests now appear to which the preschool child is not subjected. For example, the superior adult is asked to perform again the Binet paper-cutting test in which the examiner says, "Watch carefully what I do. See, I fold the paper this way. Then I fold it this way, and then this way. Now I will cut out a piece right here." Those of you who have been through it, either as a trained examiner or a superior adult, will recall that at this point the person being tested must make a little drawing to show where the holes will appear when the paper is unfolded.
>
> It is easy to indulge in a little playfulness at the expense of test items, but I am trying to show that there is no essential change in the ideology of Binet testing, as we go up the scale from age two to age eighteen. (p. 535.)

Terman,[2] some years before, had given his opinion:

> Whatever the relative contributions of nature and nurture to the subject's present intellectual status, the determination of the present status is of the utmost importance. This is true for children of every age and of every level of ability, for unless we know where the child is in his development there can be no possibility of directing his training intelligently. The problem is especially important, however, in the case of children of preschool age who are exceptional in the direction of either inferiority or superiority. (p. ix.)

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[1] Stoddard, George D.: Intellectual Development of the Child: An Answer to the Critics of the Iowa Studies. *School and Society*, 1940, 51, 529–536.

[2] Terman, Lewis M.: Editor's Introduction [In] Stutsman, Rachel: *Mental Measurement of Preschool Children.* Yonkers-on-Hudson, N. Y.: World Book Company, 1931. Pp. x, 368.

The plain truth is that a child who is rated as feeble-minded today may be institutionalized — today!

There is something wrong with the standardization of an individual or group test if the best measurement of mental status does not also furnish the best prediction. Such a defect would imply either that we had no concept of a mental growth pattern running from childhood to adulthood or that we were unable to prepare appropriate tests. The mental age or point score must not make concessions that disturb present validity. If a series of measurements valid at the time does not permit a good prediction, then indeterminism is in itself a psychological phenomenon. (It is all right to construct a purely prognostic test, provided that we do not utilize it for other purposes. But there is a circularity in predicting the weight of Bill Jones to be 100 at age twelve, and *from that datum* estimating his present weight at age six.) Nevertheless we are in sympathy with Anderson's suggestion that something besides age progression be used in evaluating mental tests. It would be helpful to have correlations with later test results, with special reference to measurable items like vocabulary. The judgment of clinicians could be utilized. Tasks saturated with the attributes of intelligence could be devised for levels of response above the first year.

THE AIM OF INTELLIGENCE TESTS

A brief quotation from Freeman [1] illustrates the standard teaching of educational psychologists:

> The aim of intelligence tests is, so far as possible, to so choose the materials of which they are composed that the effect of differences in experience will be reduced to a minimum, and this aim has in a measure been attained. No one would claim, however, that the attempt has been completely successful. (p. 256.)

Freeman goes on to observe that, in group mental testing, differences in scholastic experience may result in wide differences in test accomplishment. We may say the same for individual Binet testing and for all tests except those that are "culture-free" in type. But all this is a chasing of the will-o'-the-wisp; it is beside the main point. *To throw out experience is to throw out a proper*

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[1] Freeman, Frank N.: *Mental Tests: Their History, Principles and Applications.* Boston, Mass.: Houghton Mifflin Company, 1939. Pp. x, 460.

source of nourishment to a growing mentality. We shall never succeed in measuring differences in physique ascribable to differences in nutrition if we measure only persons who live on potatoes. We shall never explore the riches of the intellectual life nor approach its limits by constant attention to the fragmentary and the desultory.

With a slight modification in language, the gap between long-held concepts in psychology, as typified by Freeman, and the position we are taking in this volume may be bridged: *the aim of intelligence tests is to provide materials such that differences in experience that do not contribute to differences in intelligence will be minimized.* It should never be the aim of intelligence tests to reduce all differences in experience to a minimum, for in this attempt we turn away from essential meaningfulness. The aim always is to measure ability, regardless of the way in which it was developed. We may be confident that the type, richness, and duration of experience are built into the very structure of intelligent behavior. One neuromuscular mechanism may run full tilt into problem situations, resolving some of them, while similar mechanisms may run away or lean upon irrational and emotional props. Wedgelike, this practice may widen differences that were initially small. *To be intelligent is not only to have something and to be something, but habitually to do something.* There is no neurology as yet subtle enough to distinguish the intellectually deteriorated escapist of today from himself of yesterday who had not then embraced spurious substitutes for logic. In the grim world of the 1940's there is no more deadly phenomenon than this vulnerability of men in high places to arguments and conclusions clearly seen as false by the unspoiled dull.

In order to get at differences in mental processes, or in factors that have been located and then named in meaningful psychological terms, we may profitably ask each subject to give a running account of his inner speech as he attempts the solution of a test-item. For example, in tests of spatial relationship there may be cues that can be verbalized, thus affecting performance. Problems in descriptive geometry can be solved with facility in two divergent ways: (*a*) through a relatively pure utilization of form and movement, or (*b*) through an extreme verbalization of all the steps involved in the various projections, rotations, and relationships. From the final solution there is no way to tell what process was employed and this could be true even if one process were usually inferior to the other. Here indeed is an opportunity for laboratory technicians in psychology to provide for the simultaneous recording of internal speech, together with certain responses in eye movements, voluntary and involuntary muscular movements, emotional concomitants, and brain waves — all to be followed by a synthesis in terms of the total behavior of the subject under highly standardized conditions. In this situation, the subject is not simply presented with a question or a paper and pencil, but is made the focus of psychological testing. He is gone over like a car in the hands of an expert mechanic.

But the mental tester, whether through conversation or composition, still has left to him the crucial assignments. All the processes indicated above are merely indicators. They are not the thing-in-itself, and never can be, for intelligence is a social concept related to cultural exchange and to a set of values in which no one intellectual preoccupation is all powerful. As the paragon in memory may be dim-witted, so the incredible abstractionist may be incapable of prudence in everyday affairs. The concept of intelligence implies the presence of a governor that will keep one's neural mechanism and social interconnections in good working order. High speed and tremendous efficiency are approved, provided they do not tear things apart. Intelligence-at-the-moment, as distinguished from the complete pattern of growth,. will extract its validity from what the subject can now do, even though deterioration is a plausible prognosis. To ask for repeated testing is to admit at once the unreliability of tests and the possibility of a shift in the intellectual status of the subject. Estimates of constancy, of acceleration, or deceleration are based on the extrapolation of curves of growth; there is no expectation in any direction except that which arises from experience with the population tested. As we have seen, predictions suffer also from actual changes in one's concept of mental testing appropriate to a given age.

Nevertheless, such considerations need not stand in the way of continued efforts to extend testing downward and upward, and finally to achieve an integrated pattern of appropriate items.

TESTS FOR INFANTS AND YOUNG CHILDREN

Related to the well-known work of Gesell,[1, 2] M. C. Jones,[3] and Shirley[4, 5] on the all-round development of infants and young children are various attempts to construct standardized mental tests and scales for the early age ranges.

The Merrill-Palmer Scale

Stutsman[6] utilized the following principles in assembling the Merrill-Palmer Scale of Mental Tests:

(1) Test materials of interest to the child.
(2) A large variety of activities.
(3) Variation in test difficulty.
(4) Tests "influenced as little as possible by the child's training and environment."
(5) Simplicity of material; ease of administration and scoring.
(6) Marked differentiation between the age groups:

> Within limits, the more rapid the decrease in the difficulty of a test with increasing age, the greater is the diagnostic value of the test. The age value of a test is the age at which 50 per cent of the children are successful. . . . The age range of each group should be small enough to prevent a high positive correlation between the score and the age of the child within the group. This ideal is a difficult one to attain with young children. Since mental growth is very rapid during the preschool years, the age range of the test groups must be small. (pp. 46, 47.)

(7) A representative sampling.

The tests, which are chiefly of the performance type, were standardized on 677 children drawn from the Merrill-Palmer

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[1] Gesell, Arnold: *The Mental Growth of the Pre-school Child: A Psychological Outline of Normal Development from Birth to the Sixth Year, Including a System of Developmental Diagnosis.* New York: The Macmillan Company, 1926. Pp. x, 447.

[2] Gesell, Arnold: *Infancy and Human Growth.* New York: The Macmillan Company, 1928. Pp. xvii, 418.

[3] Jones, Mary Cover: The Development of Early Behavior Patterns in Young Children. *Journal of Genetic Psychology,* 1926, 33, 537–585.

[4] Shirley, Mary M.: *The First Two Years: A Study of Twenty-five Babies.* Vol. I: Postural and Locomotor Development. Minneapolis, Minn.: University of Minnesota Press [*c.* 1931]. Pp. xv, 227.

[5] *Ibid.,* Vol. II: Intellectual Development. Minneapolis, Minn.: University of Minnesota Press [*c.* 1933]. Pp. xvi, 513.

[6] Stutsman, Rachel: *Mental Measurement of Preschool Children: With a Guide for the Administration of the Merrill-Palmer Scale of Mental Tests.* Yonkers-on-Hudson, N. Y.: World Book Company, 1931. Pp. x, 368.

School waiting list, public and private schools, and child-care agencies. As Stutsman says:

> It was considered inadvisable to use the test results from the children attending the Merrill-Palmer nursery school in the standardization. The environment surrounding these children is so enriched that a few months' attendance in the school is sufficient to alter markedly the standing of the children on tests already standardized. (p. 70.)

From the period eighteen months to seventy-seven months, there were available from fifty to eighty children for each six-months' interval. Some problems involved a method of combining the variable-score tests with the all-or-none tests, and the treatment of refusals. The first was met by reducing the items to an all-or-none basis of scoring. The analogue of increase in percentage passing was used, namely a significant decrease in the time taken successfully to complete a test-item. Seventy-six all-or-none test elements were made up out of the twenty variable-score tests, making a total of ninety-three all-or-none test-items. Some tests were scored for both time and error. The ninety-three elements were located according to difficulty as follows:

> In this operation, called the calculation of the age at which a given test element is "at par," the percentage of each age group succeeding in the separate test elements was first determined. This process gave a series of gradually increasing percentages from 0, or slightly above, to 100, or slightly below, for each of the test elements. The 50 per cent point in each of these series was of interest. If at 27 months only 14 per cent of the children could do the Seguin Form Board test correctly in two out of three trials, and at 33 months 62 per cent of the children were able to do it, at what age were exactly 50 per cent of the children successful? Obviously, this age lay somewhere between 27 and 33 months, and interpolation was necessary in order to locate it. The formula
>
> $$\text{age at par} = Y + \frac{0.50 - p_1}{p_2 - p_1}$$
>
> — in which p_1 and p_2 represent the percentages of correct responses immediately above and below 50, and Y represents the age which has p_1 correct answers — was used in interpolating between the various percentages. The "age at par" for the Seguin Form Board was thus found to be 31.5 months. . . .
>
> The most satisfactory procedure in correcting for these omissions and refusals, it appeared, was to count as successes all refused or omitted tests below the level of the child's attainment on the whole

> scale, and to count as failures all occurring above this level. It was thus possible to score performance in terms of successes without reference to the number of failures, as was done in the case of tests in which no omissions or refusals occurred. (pp. 94, 95.)

The child's total score was calculated in a cumulative fashion, as indicated above.

Some of the scoring troubles of test makers and test users can be illustrated [1] from the Woodworth and Wells Action Agent Association Test which is an item in the Merrill-Palmer Scale; it is apparent that differentials in diction and hearing acuity enter into the situation.

Item	*Passing*	*Failing*	*Doubtful*
(1) What sleeps?	Doll	In bed	My feet
(2) What scratches?	Scratchy things	Scratch somebody	Child shows finger nails
(3) What flies?	Chickens	Ink	Paper
(4) What bites?	Girls	Bike	Birdies
(5) What swims?	Kids	A little baby	Boats
(6) What burns?	Teakettle	Bird	Fire engine
(7) What cuts?	Bread	Cat	Oranges
(8) What blows?	Toot toos	Street	People
(9) What shoots?	Boy	Cards	Steam
(10) What melts?	Steel	Water	Sun
(11) What sails?	Sailor man	Horses	Man up in the sky
(12) What boils?	Stove	Boys	Cook
(13) What floats?	Wood	Water	Dolls
(14) What growls?	Cow		A frog
(15) What stings?	Worms	Perfume	Court plaster
(16) What gallops?	Pigs	Alligators	Doggies
(17) What aches?	Toothache	What chickens make	People
(18) What explodes?	Electricity	Icebox	Heater
(19) What roars?	Imitation of roaring	Wheels	Soldiers
(20) What mews?	Cat	Victrola	Animals

Apparently item difficulty and teachers' judgments on brightness and dullness were the chief criteria employed in standardizing the tests. Stutsman reports a correlation between chronological age and score (for 631 cases) of $r = .92 \pm .00$. These data excluded children "who were judged by other criteria to be feeble-minded or very superior. The correlation is sufficiently high to indicate a high degree of relationship between the chronological age and the test score. It is not, however, so nearly perfect that it excludes the possibility that there are other variables present in the test scale which differentiate children of the same chronological age. In other words, it cannot be said that the scale is measuring chronological age alone." (p. 111.) But the Merrill-Palmer Scale does approach a fair measure of chronological age. Corrected for attenuation and range of talent, this correlation would be really substantial. For 115 children at the Merrill-Palmer School the correlation between the Stanford Revision and the Merrill-Palmer test was .78 ± .03.

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[1] Stutsman, Rachel: ***Mental Measurement of Preschool Children: With a Guide for the Administration of the Merrill-Palmer Scale of Mental Tests.*** Yonkers-on-Hudson, N. Y.: World Book Company, 1931. Pp. x, 368. (pp. 146–148.)

Wellman[1] made an intensive study of preschool children as measured by the Merrill-Palmer tests.

> The major aim of the present investigation was to study the effects of preschool attendance upon intelligence as measured by the Merrill-Palmer scale. Secondary aims arising out of the primary one were: to make a critical study of the Merrill-Palmer scale as an intelligence test for preschool children, with particular reference to suitability of the scale for use in obtaining consecutive measurements, sex differences, and validity; to compare the Merrill-Palmer scale in the above respects with other scales, notably the Kuhlmann and Stanford revisions of the Binet scale, and to a limited extent, the Minnesota Preschool scale; and to compare our findings with those of other investigators. (pp. 7–8.)

Five hundred and ten Merrill-Palmer tests were administered to 281 children 20 to 62 months of age, distributed as follows: Iowa preschool laboratories, 208; Cedar Falls nursery school, 11; Mooseheart, Illinois, 17; Davenport orphans' home, 45. The mean chronological age was 41 months, the standard deviation, 10. The mean mental age was 46. Intelligence quotients ranged from 61 to 162, with a mean of 111 for the total group and 117 for the preschool laboratory group. The correlation between mental and chronological age for the total group was .81 ± .01.

Wellman carried out her analysis on the basis of the three methods of scoring: sigma score, percentile rank, and intelligence quotient. In summary, Wellman says:

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[1] Wellman, Beth L.: The Intelligence of Preschool Children as Measured by the Merrill-Palmer Scale of Performance Tests. *University of Iowa Studies in Child Welfare*, 1938, 15, No. 3. pp. 150.

> One fact that emerges rather clearly from the present study and from the results of other investigators is that gains may generally be expected on retests. These gains have been variously explained by different investigators, most frequently as practice effects or unreliability of the test. The present investigation has contributed to this problem by demonstrating that the pattern of change on retest at one week was quite different from the pattern of change over a longer period, such as six months. Amount of change in a one-week interval was positively correlated with initial IQ, indicating that the brighter children made the greatest gains, while at a six-month interval amount of change was negatively related to initial IQ, indicating the greatest gains were being made by the duller children . . . it appears that the Merrill-Palmer test is not quite as adequate a test for the preschool ages as the Binet test. However, it appears to measure a different set of abilities to a considerable extent, and therefore might be retained as a supplementary test. The relatively low agreement with a simultaneous Binet indicates that it cannot be substituted for the Binet with any great assurance of comparable results. Whether the Merrill-Palmer presents a continuum with performance scales at later ages remains to be demonstrated, there being no evidence available at this time A point decidedly in favor of the Merrill-Palmer test is that children and examiners like it . . . one of the difficulties with the Merrill-Palmer scale is its reliance on small differences in speed of performance for crediting the performance at different levels. (pp. 144, 147.)

There is general agreement that the Merrill-Palmer tests are heavily weighted with motor skills, and that the IQ's derived from it share the common defect of a change in meaning with advance in the age bracket tested: a stated IQ does not signify a given distance from a mean.

Iowa Tests

The Iowa Tests for Young Children validated by Fillmore[1] are the culmination of twelve years of work on tests at these ages. Forty-nine tests were analyzed, covering the age range from four months to two years. These tests (with the "age at par" in months) are listed below:

1. Sitting on lap, unsupported (4.2).
2. Accepting second cube (4.5).
3. Taking cup off hidden object (4.5).

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[1] Fillmore, Eva A.: Iowa Tests for Young Children. *University of Iowa Studies in Child Welfare*, 1936, 11, No. 4, pp. 58.

4. Attempting to stand (4.6).
5. Reacting to image in mirror (4.7).
6. Locating sudden sound (4.7).
7. Carrying ring to mouth (4.8).
8. Examining object (5.3).
9. Looking on floor for fallen object (5.5).
10. Sitting on table or floor unsupported (5.7).
11. Attempting to ring bell (6.4).
12. Showing interest in picture (6.6).
13. Poking at pellet (7.3).
14. Ringing bell (8.3).
15. Raising self by chair (8.6).
16. Hunting covered object (8.7).
17. Picking up pellet (9.1).
18. Walking with help (9.6).
19. Trying to put cork in bottle (11.0).
20. Trying to put penny in bank (11.1).
21. Marking with pencil (11.4).
22. Accepting third cube (11.7).
23. Placing cubes in box, score 3 (11.9).
24. Trying to put sand in jar (12.2).
25. Putting two boxes of nest together (12.4).
26. Putting cork in bottle (12.4).
27. Putting penny in bank (12.7).
28. Piling some blocks (13.2).
29. Placing Wallin pegs, score 5 (14.5).
30. Placing cubes in box, score 8 (14.7).
31. Putting three boxes of nest together, or two nests (15.0)
32. Throwing ball to examiner (15.2).
33. Putting sand in jar, awkwardly (15.3).
34. Pointing to object in picture (15.3).
35. Skeels form board, 3A, score 2, forms (15.5).
36. Putting key in padlock (16.4).
37. Placing cubes in box, score 11 (16.4).
38. Rolling ball back to examiner (19.7).
39. Pointing to features, score 4 (20.1).
40. Unscrewing lid of jar (20.3).
41. Skeels form board, 3A, complete 40″ (20.4).
42. Placing cubes in box, score 15 (20.4).
43. Skeels form board, 5A, complete 117″ (20.5).
44. Naming object in picture (21.1).
45. Putting sand in jar, good performance (21.4).
46. Drawing circle, hand guided (21.6).
47. Putting nest of boxes together (21.8).
48. Boxes and covers, shapes differing, three matched (22.1).
49. Skeels form board, 3A, 24″ (23.4).

Most of the Iowa materials are simple and inexpensive. The directions for giving and scoring the tests are explicit. The first analysis of results was based on 643 records of children from 1 month to 40 months of age. The items are validated on the basis of percentage passing. A regular rise in this percentage was demanded if a test was to be retained, although some items were eliminated that were too difficult to administer or score. The Iowa scale is a point-scale, each test-item being placed at par[1] according to the formula mentioned above by Stutsman. Class intervals for age groups ranged from 2 to 3 months. Data on reliability were secured by breaking the scale into three sections as follows: 5½ months to 9½ months, 9½ months to 13½ months, and 13½ months to 17½ months. The reliabilities obtained by the chance half method were, respectively, .90, .93, and .88. The norms available are too high for the general population, since they were based on children in the Iowa preschool laboratories. The prediction of verbal items in mental tests and of subsequent IQ's is low.

The difficulty of measuring language aptitudes in the infant and preschool years is a major barrier in establishing the long-range validity of mental testing. While performance tests are inadequate, little attention has been paid to the intensive analysis of whatever language ability is present. The measurement of language forms, under standardized conditions, for children as young as eighteen months and its continuation up through the higher ranges of adult intelligence (as represented in the foreign language examination of the Iowa Placement series) would constitute a genuine advance.

P. Cattell[2] has observed:

> Several investigators, including Fillmore (Iowa Tests for Young Children), Bayley (Mental Growth During the First Three Years), and others, have scaled the Gesell tests or modifications of them by means of Thurstone's method of absolute scaling. They have all found an unequal distribution of items. Fillmore, for example, who eliminated all items of a personal-social type and included only a small number of tests of large muscle control, such as sitting and

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[1] Thurstone, L. L.: A Method of Scaling Psychological and Educational Tests. *Journal of Educational Psychology*, 1925, 16, 433–451.

[2] Cattell, Psyche: *The Measurement of Intelligence of Infants and Young Children*. New York: Psychological Corporation, 1940. Pp. 274.

> standing, found one item between six and seven months and five between eleven and twelve months; none in the two months' interval between seventeen and one-half and nineteen and one-half months, but nine in the two months' interval between twenty and twenty-two months, and so on. (p. 22.)

Cattell has listed what she regards as the chief sources of inadequacy in infant and preschool testing (pp. 20–21.):

> 1. The lack of objective procedures for administering and scoring the items, due in part to the types of items selected and in part to the lack of clear, precise directions.
>
> 2. The inclusion of a large proportion of items of a personal-social nature, the responses to which are influenced to a marked degree by home training.
>
> 3. The inclusion of a number of items which are indicators of the development of large motor control which are probably only indirectly related to mental development.
>
> 4. The lack of scaling which makes impossible other than descriptive ratings.
>
> 5. The small age range which the series of items covers.
>
> 6. The unequal distribution of the items over the age range covered.
>
> 7. Poor standardization.

It is clear that some of these difficulties are inherent in mental testing at any level.

THE VINELAND SCALE

Doll[1] in recent years has undertaken the construction of a scale of social maturity. The items employed and the theory behind them are of interest:

> At first thought, these items may seem to have been chosen at random. On the contrary, in spite of their homely character, each item reflects careful consideration, not only of its place in the hierarchy of personal social competence, but also with respect to its relative freedom from the influence of such factors as intelligence, personality, emotionality, environmental opportunity, and so on, as such. Sex differences and the influence of age, experience, special skills, and the like have also been avoided as far as practicable. In

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[1] Doll, Edgar A.: The Vineland Social Maturity Scale. *Training School Bulletin*, 1935; 32, Nos. 1–4, 1–7; 25–32; 48–55; 68–74.

> the main, the items represent performances which have a rapid development over a narrow span of years, and which reflect the more or less spontaneous consequences of the individual's increasing progress toward dominating his environment.
>
> The underlying principles involved in the construction of this Scale are much the same as those employed by Binet and Simon in constructing their intelligence scale. Each item is conceived as representing a general growth in social responsibility which is expressed in some detailed performance as an overt expression of that responsibility. Consequently, the value of the detailed items is to be determined principally by the extent to which they reflect this personal independence in social activities, in respect to which the detailed performance is otherwise relatively unimportant. (p. 3.)

Many of the items are like those included directly in mental measurements, particularly in the early years. They will be found, for example, in the Gesell Schedules, the Iowa Tests for Young Children, the California Mental Scale, and the Binet revisions. The scale is permeated with factors arising from cultural and social opportunity. A child will use a table knife for spreading if one is available and if that is the custom in the family. He will make telephone calls if a telephone is available. The scale may be useful as a check upon parental practice. Ten items selected in sequence in the center of the schedule illustrate this point (there are 117 items altogether):

74. Writes occasional short letters.
75. Uses tools or utensils.
76. Carries out written instructions.
77. Makes telephone calls.
78. Does small remunerative work.
79. Goes about home town freely.
80. Makes minor purchases.
81. Exercises complete care of dress.
82. Answers ads; purchases by mail.
83. Does simple creative work.

Doll states that the scale

> . . . is useful in distinguishing between mental retardation with social incompetence (feeble-mindedness) and mental retardation without social incompetence, which is often confused with feeble-mindedness. It also affords assistance in child guidance and child training, by indicating the relative aspects of social competence. It provides another means of evaluating the influence of environ-

> ment, of cultural status, and the effects of such handicaps as blindness, deafness, or crippling. In short, the social status of the individual is the basic point of departure for a large variety of practical uses in scientific studies in those social sciences where human adjustment is a consideration. (p. 7.)

Doll's designation of maturity levels should not be taken too seriously. Much depends on how the skill or behavior pattern is conceived and measured. The test responses are gleaned from various sources, not necessarily by a direct examination of the subject. This permits a great deal of subjectivity. The scale as a whole may best be viewed as an outline for a clinician's interview concerning a child.

CHAPTER V

POINT-SCALES

ARMY ALPHA

Some findings relating intelligence to various factors and conditions are based on group tests that stem largely from Army Alpha. The purpose here is to utilize a few point-scales and group tests as illustrative of certain practices in test construction, practices that reveal what intelligence tests are and what may be expected of them as measures of human behavior. Later we shall discuss some testing enterprises that constitute new departures.

The major reports from the Army mental testing[1, 2] led to the "discovery" of an average mental age for the American soldier of around thirteen years. This precipitated a widespread controversy, for it seemed to be a derogation of the intellectual status of the adult male population of the country. A common explanation of this phenomenon has been advanced by Freeman:[3]

> Nearly 50 per cent of the men, in other words, were rated according to this scheme as below a mental age of thirteen years. A similar method of figuring gives an estimate of 40 per cent as being below a mental age of twelve years. Now it has been the practice of psychologists to interpret a mental age of twelve years, when the individual is mentally mature, as representing marked dullness. Reckoning a normal adult as having a mental age of sixteen, one whose mental age was twelve would have an I.Q. of 75 ($\frac{12}{16} \times 100$). If we refer back to Terman's distribution of I.Q.'s, we shall see that only between two and three per cent of children have an I.Q. as low as this.
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> This enormous discrepancy between the percentage of 40 for adults and two or three for children leads us to inquire how the

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[1] Yerkes, R. M. [Editor]: *Psychological Examining in the United States Army.* Memoirs of the National Academy of Sciences. Washington, D. C.: Government Printing Office, 1921, 15, pp. 890.

[2] Yoakum, Clarence S., and Yerkes, Robert M.: *Army Mental Tests.* New York: Henry Holt and Company, Inc., 1920. Pp. xiii, 303.

[3] Freeman, Frank N.: *Mental Tests: Their History, Principles and Applications.* Boston, Mass.: Houghton Mifflin Company, 1939. Pp. x, 460.

> equivalent mental ages were determined. They were got in this fashion: A carefully selected group of men were given the Army Alpha, and also the Stanford-Binet. The Stanford-Binet mental ages of these men were found. By a comparison of these mental ages with the Alpha scores of the same men, the mental ages which are equivalent to the various Alpha scores were calculated. This procedure assumes that scores made by children and by adults on the same mental test represent equivalent mental capacities. The results of the army test seem to give conclusive evidence that this assumption is not correct. While the discrepancy may be explained in part by other minor factors, the chief explanation must be this lack of equivalence of the results of the test given to children who are in school and are accustomed to doing tasks similar to those demanded by the tests, and to adults who have been out of school for from six to ten years or more, and have lost a good deal of their adeptness for performing tasks which involve clerical skill. It is unsafe, therefore, to interpret the mental-age ratings of adults, when they are obtained in this way, as meaning the same thing as they have been found to mean in our experience with children. (pp. 127–128.)

According to this interpretation, intellectual ability as measured by a test is rendered invalid unless a reasonable amount of practice is inferred. *It is a rather neat way of saying that intellectual capacity is dulled by disuse.* What is true of a whole army of men is true with respect to scholastic differentials among children. There are many homes in which there is little incentive to grow in vocabulary and language and many schools where the premium is not upon linguistic experience, problem solving, and originality, but upon silent woolgathering. Should we not assume that the symbol-awkwardness that plagued soldiers indicates a block to the solution of abstract problems in life, and further that a child's familiarity with symbolic materials is a genuine mental facilitation? Of course, neither of these assumptions will be sound to the extent of the measured differences between adults and children. No meaningful conclusions as to the distribution of adult mental ability could be drawn from the Army use of the old Stanford-Binet, a test that had been "standardized" largely without benefit of adult responses.

Army-type tests involve quick reactions to a large number of small items. The tests are geared to time limits. This speed factor is not the same as the attribute of *economy*. At best, speed as applied to a mental test is an elusive factor or condition. In the ordinary situation, whether in a group test or an age-scale, the subject starts with easy items and works his way up. Easy homogeneous materials are likely to be accepted as calling for speed, the score being the number of items correctly answered (or a derivative). Speed is less important as we rise above a plane of motor or simple mental tasks. At high levels of abstraction, test-items will be failed no matter how much time is allowed. Plainly a so-called speed factor produced by inadequate time limits or harassment during the testing period is neither a good test of speed nor of altitude.

The early work of Ruch and his associates[1,2] indicated high correlations for group tests of mental ability (such as Army Alpha and the Terman Group Test) as between testing with standard time limits and with an unlimited time allowance. These testing programs were based on school and college students. To quote Ruch and Koerth:

> Admitting that Army Alpha is largely a *speed* test, the fact that single time correlates 0.966 with double time, and 0.945 with unlimited time indicates that the *speed* factor does not seriously invalidate the test. In fact, it can be shown from figures already presented that the probable error of estimating scores for double time and for unlimited time from scores earned in single time is about 6.7 and 8.4 score points, respectively.
>
> Increasing the time allowances does not permit dull subjects to equal the scores of the more intelligent subjects. In fact the mean of the low group for unlimited time was still well below the mean of the high group for single time. (p. 207.)

But Freeman[3] interprets Ruch's correlations as indicating that the Army Alpha is really a speed test. It is true, as Freeman contends, that in a speed test, e.g., card sorting, doubling the time will result in high correlations between single and double time. Still, by definition, doubling the time in a power test will also result in high correlations. Therefore nothing can depend

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[1] Ruch, Giles Murrel: The Speed Factor in Mental Measurements. *Journal of Educational Research,* 1924, 9, 39–45.

[2] Ruch, G. M., and Koerth, Wilhelmine: "Power" vs. "Speed" in Army Alpha. *Journal of Educational Psychology,* 1923, 14, 193–208.

[3] Freeman, Frank N.: *Mental Tests: Their History, Principles and Applications.* Boston, Mass.: Houghton Mifflin Company, 1939. Pp. x, 460. (p. 265.)

upon this particular determination. Can speed be a factor if speed is eliminated?

In any consideration of the relation between speed and power it must be recalled that a high correlation between two factors does not indicate their equivalence. The correlation between height and weight is substantial, but the two attributes are different. Similarly for many geometrical and scientific relationships. On the other hand if the correlation is low, as it is between performance on simple motor tasks and on highly abstract materials, we may assume that we are measuring different functions. Between the extremes there will be undifferentiated mixtures of functions, dependent not only on the nature of the test but on the conditions of its administration.

With respect to Army Alpha, the joker lies in the fact that the speed of performance is applied to the solving of mental problems. Speed of performance, as in card sorting, is scarcely related to general intelligence as measured in Army Alpha. If a power test is speeded up markedly, it ceases to be either a power test or a speed test. Of course ample time should be allowed to perform each test in a power series, for example in the Binet repetition of digits. This is different from a long time or unlimited time. In weight lifting ample time may be simply the few seconds required to take a heavy object off the floor. A graded series of such units would indeed look like a speed test. But the "speedy" person without power would not lift any at all, and the "powerful" person with the speed factor eliminated would hardly be able to lift more. In both physical and mental tests *power* refers to maximum output, to the best performance under conditions which permit it to be exhibited.

OTHER POINT-SCALES

Doubling the time in Army Alpha does not make everything hinge upon speed; it eliminates this factor. With unlimited time, a test can become truly a power test, but with reduced time, mental tests are still essentially power tests. For an item in most mental tests the first question is, Can this child do it; secondly, Can he do it in a short amount of time? It is not a question of an ability to pass possessed by all persons taking the test, with time as the main differential. As soon as differentials arise in the final ability to solve a problem, with little or large amounts of time, we no longer have a good test of speed. The speed factor, at the choice of the subject, may be ruled out by his stubborn attention to a single hard item. The sooner he strikes such an item in a series of graded tasks, the sooner does the test become a power test.

The foregoing discussion applies, with some qualifications, to all point-scales. The differences between an age-scale and a point-scale have been tabulated by Yerkes and Foster,[1] as follows, although this arrangement suggests a dichotomy that cannot be clearly established:

	Binet Characteristics	*Point-scale Characteristics*
(1)	Multiple-group, age or year scale	Single graded-test scale
(2)	Selection by relation of successes to age	Selection by function measured
(3)	Varied, unrelated, ungraded tests	Each test so graded as to be available for wide range of ages
(4)	Internally standardized and inflexible	Externally standardized and flexible
(5)	All-or-none judgments	More-or-less judgments
(6)	Qualitative	Quantitative
(7)	Measurements only slightly amenable to statistical treatment	Measurements wholly amenable to statistical treatment
(8)	Tests weighted equally	Tests weighted unequally
(9)	Implicit assumption, that of appearing functions	Implicit assumption, that of developing functions
(10)	Measurements for different ages relatively incomparable	Measurements for different ages relatively comparable

Yerkes stated in 1917:[2]

> . . . It is assumed in the construction of the Point Scale that all of the important types of intellectual function are present in early childhood and develop more or less rapidly. If this be true, tests or measures for all fundamental forms of intellectual behavior should be available no matter what the age of the subject. Briefly put, the Binet is an age-scale based upon the assumption of *appearing functions;* the Point Scale is a functional scale, based upon the assumption of *developing functions.*
>
> Genetic psychology justifies the statement that all important types or classes of intelligent behavior are represented in the human action system by the end of the third year of postnatal life. There-

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[1] Yerkes, Robert M., and Foster, Josephine Curtis: *A Point Scale for Measuring Mental Ability.* 1923 Revision. Baltimore, Md.: Warwick & York, 1923. Pp. vii, 219. (p. 156.)

[2] Yerkes, Robert M.: The Binet Versus the Point Scale Method of Measuring Intelligence. *Journal of Applied Psychology,* 1917, 1, 111–122.

> after new acts belonging to the same types continue to appear for some years and all tend to become complexly related to one another and to innate reactive tendencies. (p. 113.)

The Yerkes-Foster point-scale covers an age range from three to sixteen, with its chief accuracy between six and twelve. Scores range from 0 to 100. The items are derived primarily from Binet. Items were chosen so as to be applicable through a considerable range of years, differential reactions to the same test indicating different stages of mental growth. There are over fifty questions arranged in twenty tests. A table of norms is provided to show "at what chronological age the average child attains that particular score, and this is, of course, the mental age of our subject. The IQ is obtained in the usual manner by dividing mental by chronological age." (p. 8.)

The Arthur Point Scale of Performance is available for year six and above. It comprises a restandardization of form board material from the Pintner-Paterson performance scale, together with a few other tests. The scale is validated in terms of percentage passing as one moves up the chronological ladder. It is sometimes regarded as a substitute for a standard individual intelligence test or as a supplement to it. Since the Arthur scale depends less upon verbal functions than does the Binet, it is often used with alien or handicapped children. Brown[1] sounds a warning regarding it:

> . . . the clinician must not take the results too seriously especially for older dull children. Tests such as the *Seguin Formboard*, the *Casuist Formboard*, and the *Mare and Foal Test* are for children at this level more tests of speed-of-motor-performance than tests of "intelligence." Frequently older dull children of juvenile court age make relatively high scores on the performance tests which are entirely discrepant with performance in school, in shop, in the community or with clinical impressions. (p. 202.)

Tests in point-scales, as in the Pintner-Paterson Performance Scale, are separately standardized, and as Yerkes maintains, they could render good service in research. Actually the scales tend to become static, revisions rarely being undertaken. While the Yerkes-Foster tabulation indicates that Binet items are scored

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[1] Brown, Andrew W.: [In] Buros, Oscar Krisen [Editor]: *The 1940 Mental Measurements Yearbook.* Highland Park, N. J.: The Mental Measurements Yearbook, 1941. Pp. xxiii, 674.

"all-or-none" and Kuhlmann asserts[1] that this is the correct method, the fact is that the new Stanford Form L calls for: the identification of four out of six objects (II, 2); identifying three out of four parts of the body (II, 3); four or more blocks in a tower (II, 4); naming two pictures correctly out of eighteen (II, 5); three successes out of three trials (or five out of six) in the comparison of sticks (III–6, 3); two out of three trials in naming objects from memory (IV, 2); and three out of three in aesthetic comparisons (IV–6, 1). There is a variation from one out of *n* to *n* out of *n*, in securing a passing mark for a given mental age increment. Nevertheless the age-scale is rigid in type and wasteful in its utilization of the gradations discovered.

THE WORK OF THORNDIKE

Thorndike's views on mental testing are brought out in his 1927 volume on the measurement of intelligence. Speaking of Stanford-Binet, Army Alpha, and the National Intelligence tests, he says:[2]

> A is rated as more intelligent than B — first, if he can do certain hard tasks with which B fails, second, if he can do a greater number than B can of tasks of equal difficulty, and third, if he can do more rapidly than B tasks at which both succeed. The only sure statement of what abilities the Army Alpha measures is to show the test itself and its scoring plan . . . nobody has ever made an inventory of tasks, determined the correlation of each with intellect, selected an adequate battery of them, and found the proper weight to attach to each of these. (p. 2.)

Thorndike shows the arbitrariness of the units employed. He says of mental ages after thirteen or fourteen that they are "neither convenient nor intelligible nor realistic . . . a mental age of 15 or 16 or 17 is in fact as arbitrary a quantity as an Alpha ability of 123." Further,

> When we assert that a child is found by measurement with the Stanford Binet to have the intellect of a child 10½ years, all that is really asserted is that the child does as well in that particular

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[1] Kuhlmann, F.: *A Handbook of Mental Tests. A Further Revision and Extension of the Binet-Simon Scale.* Baltimore, Md.: Warwick & York, 1922. Pp. 208. (p. 25.)

[2] Thorndike, Edward L., Bregman, E. O., Cobb, M. V., *et al.*: *The Measurement of Intelligence.* New York: Teachers College, Columbia University [1927]. Pp. xxvi, 616.

> standardized interview as did the average of the children of 10½ years of age tested by Terman in making his standards. We do not know what the average intellect of these children was, nor how closely the Stanford Binet score represents or parallels or signifies it.
>
> When we assert that a man is found by measurement with the Army Alpha to have the intellect of an average recruit in the draft, all that is really asserted is that he does as well in that particular battery of tests scored and summated in a particular way, as the average recruit did. Just what the intellects of recruits were and how closely their Alpha scores paralleled their intellects, we do not know. The measurement is one thing, the inference to intellect is a different thing. (p. 8.)

Thorndike stresses truth, development with age, and ability to learn as criteria of intelligence. Of the first he says:

> It may be that truth-getting is what we unwittingly do measure by our intelligence tests, or what we ought to try to measure, but very few of those who devise or apply the tests think so. . . . However, valuation came in from the start because Binet tried only abilities which he valued as intellectual. (p. 16.)

Of the second criterion,

> Development with age would be a poor and partial criterion for intellect of any sort or degree, and for the higher ranges of intellect, say those above the 70-percentile intellect of the average of the white draft, or above the average ninth-grade pupil, it would be well-nigh worthless. It has never been so used. The Terman mental ages above 14, for example, are not functions of development with age, but of differences between individuals, regardless of age. (p. 17.)

The third criterion, ability to learn, has been narrowly conceived:

> Tests framed to measure how much one has learned in life so far, such as vocabulary tests, information tests, or such Binet elements as "Knows whether he is a boy or a girl," and the like, are valuable, but not, so far as we can determine, more valuable than a composite containing also tests primarily of selective, relational, generalizing, and organizing abilities. (p. 18.)

Thorndike doubts that novelty can be useful as a criterion, because what is novel will differ from one child to another. Also he holds that Spearman's "apprehension of experience," "eduction of relations," and "eduction of correlates" are inadequate to include all of intellect. Our tests have "greatly favored words, numbers, space-forms, and pictures, neglecting three-dimensional objects and situations containing other human beings." He then presents his own criteria as follows:

> (1) *Other things being equal, the harder the tasks a person can master, the greater is his intelligence.* (p. 22.)
>
> (2) *Other things being equal, the greater number of tasks of equal difficulty that a person masters, the greater is his intelligence.* (p. 24.)
>
> (3) *Other things being equal, the more quickly a person produces the correct response, the greater is his intelligence.* (p. 24.)

Of the factors listed above, Thorndike regards *altitude* (difficulty) as the most important: "The chief evidence for this is that it alone is indispensable, irreplaceable by anything save itself." This places the measurement of intelligence squarely on a foundation of individual differences, for difficulty is defined in terms of percentage passing.

No matter how extraordinary a performance may appear (*a*) to an outside observer, (*b*) in another culture, or (*c*) in another age, it is not really "difficult" if most persons can do it. In ancient and medieval times, reading and writing secured for a child or adult a high rating, with scope for differentials among those who possessed these extraordinary skills. In twentieth-century America such skills at their lower levels do not indicate high intelligence, but are, as a matter of fact, given to the feeble-minded. A striking example in the history of culture is furnished by the delivered mental power of the American Negro as compared to his African prototypes only a few generations back. It is an easy step from this to the conclusion that the human race, as it developed and utilized methods of counting, symbolizing, and communicating, lifted its intelligence above previous primitive levels. This lifting process emerged from a confluence of rapid forces in cultural change and slow forces in biological evolution, the former producing extraordinary mass uplifts in a few decades or centuries, while the latter drew upon millennia for the production of demonstrable structural change. Paradoxically, the true and inexcusable lag is cultural; more persons in the long stretch of history could have done what a few Greeks did.

Thorndike's method of validating mental tests depends on a twofold selection of items: (1) clusters of tests that behave statistically like the total series of presumably intellectual tasks, and

(2) a consensus of judges on the comparative intellectual rating of individuals. He offers a test battery and a hypothesis:

> In view of these elaborate and arbitrary restrictions, the intellectualness of our total inventory of tasks, and the intellect whose level or altitude, range or width, and facility or quickness it measures, will be called hereafter Intellectualness CAVD and Intellect CAVD (the symbol CAVD refers to the four series of tasks which constitute it — completions, arithmetical problems, vocabulary and directions). The total series of tasks concerns four lines of ability:
> C. To supply words so as to make a statement true and sensible.
> A. To solve arithmetical problems.
> V. To understand single words.
> D. To understand connected discourse as in oral directions or paragraph reading.
> The arrangement of scoring is such as to attach equal weight to each of these four varieties of tasks. (p. 65.)

Thorndike is willing to extend CAVD by adding similar "surface functions," but he maintains that all of them taken together are "mere association or connection forming"; the higher the intellect the greater the number of such connections. By granting that the number of connections is not all-sufficient as an explanatory device, Thorndike really moves toward his opponents' camp: he speaks of such factors as "strength of curiosity, satisfyingness of thought for thought's sake, and competition from nonintellectual activities and interests." Then he moves right in by postulating "a capacity for having the neurones act *with reference one to another*, that is, with *integration*." All these qualifications and postulations of other factors result in complexity. The capacities listed above are hard to distinguish from Thomson's pools and subpools to be mentioned presently.

For Spearman, Thorndike's conclusions all add to the glory of g:[1]

> . . . his "intellect CAVD" has eventually proved to represent what he calls "some unified, coherent, fundamental fact in the world."
>
> Of what nature, then, we hasten to inquire, is the evidence upon which he has succeeded in basing such a momentous conclusion? It consists, we find, essentially, and even solely, in showing that the

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[1] Spearman, C.: Critical Notice. The Measurement of Intelligence by E. L. Thorndike, E. O. Bregman, M. V. Cobb, Ella Woodyard *et al.* *British Journal of Psychology* (General Section), 1927, 17, 365–369.

> different "altitudes" in this "intellect CAVD" correlate with one another to nearly or quite as great an amount as their attenuation by random influences will permit; in other words, the correlations between the different altitudes reveal values which, on being corrected for attenuation, approach perfect unity. And of just the same nature, as we have already seen, is also the evidence upon which the authors propose to base themselves when they wish to include in their "intellect" any further tasks that did not enter into the originally chosen CAVD.
>
> Now, this line of evidence no one is less likely to impugn than myself. For it happens to be no other than the very proof which I first employed to demonstrate the existence of "*g*." Furthermore, every other proof of "*g*" advanced by our school ever since (save only the "intercolumnar correlation," which was avowedly a provisional substitute) has been just the same thing, merely put into a more convenient mathematical form. In particular, this proof by way of perfect correlation as corrected for attenuation is mathematically identical with the proof now being widely employed by way of "tetrad differences." If and when Thorndike follows up his own declared programme, and examines what further tasks not comprised in his "first choice" of the "intellect CAVD" may nevertheless — on suitably correcting for attenuation — show an approximately perfect correlation with it; if and when he does this, he will surely find, as we have done from the very beginning, that this same "unified, coherent, fundamental fact in the world" extends throughout all cognitive abilities whatever. It is neither more nor less than just our "*g*" itself. (pp. 368–369.)

Spearman's eduction of relations and correlates appears to include paragraph reading, information, and vocabulary. Thorndike believes that the original choice of materials for measuring intellect may be arbitrary. It may better be said that the tasks should not be arbitrary, although the definition must be. The tasks must then conform to the definition or to some portion of it. A *test* of intelligence may or may not be a sample of intelligent activity. If it can be shown that eye color is correlated with intelligence, then a valid test of eye color will be to some extent a "test of intelligence," but eye color will not in itself be intelligence, a structure of intelligence, nor an act of intelligence. Presumably any such correlation will appear indirectly, through racial and climatic differences leading to different cultural paths. In the American mixed population, there is a slight correlation, among children, between brightness and standing height. The factors above, in addition to selective migration, may be operating, although there is the possibility that forces of maturation within the organism are relating stem-length to neural adequacy. The low-grade feeble-minded display more physical defects than do children of normal intelligence. Conversely, when a boy proclaims his degree Oxon., he is not rooting for Oxford; he is recalling certain correlates.

From reading Thorndike, we get the idea that CAVD would be perfectly intercorrelated if perfect measures of each part were available. This would indicate the use of any one of them alone as a complete measure of intelligence — a doubtful advantage. Vocabulary and arithmetic are common school subjects; as measured, they are not distinguished either for mental richness or ceiling. The difficulties and complexities presented in these tests are of low degree, while such attributes as *adaptiveness to a goal* and *social value* scarcely come into the picture. The production of originals, a demand for concentration, and a resistance to emotional blockings are not drawn upon.

THE BELLEVUE SCALES

Recently Wechsler[1] has constructed a point-scale with special reference to adult demands. On the basis of tryouts of existing materials, he made up four related intelligence scales from the following eleven tests:

1. An Information Test.
2. A General Comprehension Test.
3. A Combined Memory Span Test for Digits Forwards and Backwards.
4. A Similarities Test.
5. An Arithmetical Reasoning Test.
6. A Picture Arrangement Test.
7. A Picture Completion Test.
8. A Block Design Test.
9. An Object Assembly Test.
10. A Digit Symbol Test.

Alternate — A Vocabulary Test.

The four separate scales are described as follows:

I. The main *Individual Adult Examination* for ages 16 to 60, consisting of the first ten tests listed, but permitting a reduction of the number to as few as seven, depending upon their suitability to the subject.

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[1] Wechsler, David: *The Measurement of Adult Intelligence.* Baltimore, Md.: Williams & Wilkins, 1939. Pp. ix, 229. (There is also a second edition, 1941.)

II. *An Adolescent Scale* for ages 10 to 16, consisting of the same tests but separately standardized.

III. *A Performance Scale* consisting of five tests (tests 6 to 10 inclusive).

IV. *A Verbal Scale* consisting of five or six tests (tests 1 to 5 and the Vocabulary as alternate).

Wechsler standardized his materials on samplings of from 50 to 195 cases for age groups running from seven to seventy years, most of the adult groupings being in class intervals of five years. Altogether there were 670 children (16 or under) and 1,081 adults (17 or above). There seemed to be a slight upward selection for his adult cases. Intelligence quotients based on the full scale averaged close to 100 for all the ages tested. This was true also of the verbal IQ's based on Scale IV. Since the quotients are based on the average test achievement in an age group, the tendency to penalize older persons is less than in the Binet age-scales.

Wechsler shows that for 75 cases, ages fourteen to sixteen, Bellevue IQ's and Stanford-Binet IQ's correlated $r = .82 \pm .03$. Bellevue IQ's correlated with teachers' ratings (high school) $r = .43$, and teachers' ratings (trade high schools) $r = .52$. He gives further data on the measurement of adults:

> . . our adult I.Q.'s, particularly those for subjects 40 years and over, will be systematically higher than those obtained by present standard scales. Older subjects require a lesser absolute score to obtain the same I.Q. Thus, to obtain an I.Q. of 100 at age 25 a subject has to attain a test score of 95; at year 35, a score of 87; at year 45, a score of 81; and so on. But even when conceding the theoretical validity of the procedure, examiners found it hard to accept it in practice. (p. 140.)

Of course Wechsler's principle of demanding less and less with advancing age is the same general idea as that of Terman and Merrill in utilizing reduced denominators after chronological age thirteen, but he applies it less adventitiously. His concept of mental age and IQ is consistent with the following:[1]

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[1] Stoddard, George D.: On the Meaning of Intelligence. *Psychological Review*, 1941, 48, 250–260.

> Certainly a mental age of fifteen is no more meaningful for an average thirty-year-old than a mental age of thirty for an average fifteen-year-old. If it is helpful to say that a six-year-old is bright, knowing full well that his mental maturity is at a low level, then we can make the analogous statement about a sixty-year-old. We do not say, "the child is bright *for a six-year-old,*" since that is redundant. Neither should we say that a man is bright (or dull) for sixty. That, too, is redundant. Either he is bright or he is not, his age being utilized as a reference point for entering the tabulation of scores. For those still older, to be bright is to postpone senility. (p. 252.)

Wechsler has made an advance, for *by definition* the average IQ of octogenarians is 100, regardless of how their performance on given tasks compares to that of ten-year-olds. As long as the clinician is confident that mental age twelve is truly superior to mental age six, he accepts the IQ concept. When it is disclosed by various criteria that mental age sixty is inferior to mental age sixteen, the whole age-scale idea tends to be discarded, even by the expert worker.

Perhaps an escape from the dilemma is to refer all mental test performances to a designated age standard, such as eighteen. In any reference to a particular age we should have to be careful to insert, at the proper time and with appropriate weighting, the new abilities being developed in the individual. It would not do to have all testing based on materials that overlap the two-year-old and the eighteen-year-old, with difficulty the only variable. At any given age we shall need' the best possible test of mental ability; conversion tables can be useful only if consistent with this concept.

Balinsky *et al.*[1] studied two groups of subjects brought to the Bellevue Hospital because of retardation, with or without behavior disorders. One group varied in age from ten to twenty-two years, with a mean age of sixteen. In this group there were thirty-six subjects who had taken both the Stanford-Binet and the Bellevue Intelligence Scale. In another group, sixty-three subjects had been given these two scales. As a criterion for the clinical validity of the tests, they used the recommendation for commitment or noncommitment to a state institution for mental defectives, such decisions being based on "a study of all the facts obtained from the case history, the psychiatric interviews and the psychological examinations and observations." The bi-serial *r*'s indicated a superiority for the Bellevue Scales over the Stanford-Binet. In view of the utilization of the psychological examinations themselves as contributory factors, with a possible staff difference in confidence in the tests, this finding needs verification.

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[1] Balinsky, B., Israel, H., and Wechsler, D.: The Relative Effectiveness of the Stanford-Binet and the Bellevue Intelligence Scale in Diagnosing Mental Deficiency. *American Journal of Orthopsychiatry*, 1939, 9, 798–801.

NEW DEPARTURES IN MENTAL MEASUREMENT

As we move into the higher intellectual levels, there is abundant evidence that group mental testing is predominant in the prediction of academic success.

Iowa Placement Examinations

By locating tests in areas closely related to the probable academic experiences of students, as in the Iowa Placement Examinations,[1] there are achieved predictions of first semester and first year academic success in college ranging from the low .30's to the high .70's, with medians (for test batteries of several hours' duration) clustering around $r = .60$.

The linkage of academic success with presumptive intellectual ability is shown in the following passage from Remmers:[2]

> The scholastic groups in terms of which the tests were, so to speak, tested were: (1) distinguished students, who were at the time of the study defined by the University regulations as those students with at least three-fourths of their grades "A" and with no failing grades; (2) probation students, i.e. those failing to carry at least twelve hours of passing work; (3) students who withdrew from the University before the end of the first semester; and (4) all students not included in these three groups. This latter group may be thought of as the "normal" group. To the extent that the test scores differentiated these groups, the tests would be shown to be valid prognostic measures of scholastic success; and to the same extent they would be valuable tools in the educational placement and guidance of students. . . .
>
> It was found that all the tests presumably measuring intellectual ability differentiated significantly among the four scholastic groups

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[1] Stoddard, George Dinsmore: Iowa Placement Examinations. *University of Iowa Studies in Education*, 1925, 3, No. 2, pp. 103.

[2] Remmers, H. H.: *A Ten-Year Review of Studies in Higher Education.* Purdue University, Division of Educational Reference, 1934. Pp. 91.

> described above. In order of decreasing average prognostic significance, the tests were: (1) American Council on Education Psychological Examination, (2) (Iowa) English Training Test, (3) (Iowa) Chemistry Aptitude Test, (4) average high school grade, (5) (Iowa) Mathematics Aptitude Test, (6) (Iowa) Physics Aptitude Test, (7) (Iowa) English Aptitude Test, (8) Purdue Reading Test, and (9) Study Outline Test. Two other tests designed to measure emotional stability were found to be practically without prognostic value for scholastic achievement. (pp. 24, 25.)

(The American Council test mentioned in the quotation above provides two scores, a linguistic score and a quantitative score, with a heavy weighting attached to the linguistic. It is regarded as a general scholastic aptitude test for beginning college students. The subtests are Army Alpha in type.)

The more highly differentiated abilities of adults, for example of college students, may be classified and measured in relation to the aptitudes and achievements in a given subject matter. The fields themselves are determined by the kind of academic experience made available to the student. Thus mathematics for the high-school or college student may mean simply whatever mathematical expectations are built up in a semester or year in terms of standard courses in mathematics. The validity of the designation *aptitude* in this connection rests upon an implied series of relationships as follows:

(1) Aptitude (for a subject or professional area) is deduced from the quality of work in that subject.
(2) The character of the work in an area is related to the character of the previous academic work.
(3) Prediction of the quality of the first portion of an academic program is of importance because of the dependent relation that further academic work holds to it.

All this can be illustrated in the field of chemistry. A chemistry *aptitude* examination has been devised that will yield fairly accurate predictions of the quality of first semester work in general chemistry. It is known that failure on the part of the student in such a test is related to failure in the year and hence to failure in the subject matter as a whole; analogously, a good showing in the test is a favorable sign. Where the student has had courses in the subject (e.g. in a secondary-school program), he may be given a *training* examination. So far as prediction is concerned, this is an improvement upon the marks already assigned in various classes and schools. The prediction of college success can be improved by combining an aptitude and a training series for those students eligible to take the training examinations.

An illustration of a practical approach to these methods of measurement is afforded by the Iowa Placement Examinations. To quote:[1]

> The Iowa Placement Examinations are perhaps the first tangible fruits of a new theoretical approach to the problem of mental measurement, in so far as the college field is concerned. For some time it has been common knowledge among technical workers that the ordinary intelligence test, when applied beyond the age of sixteen, was much more open to criticism than at lower levels; the tests available were ill adapted for measuring the superior people and the necessary assumption regarding equality of opportunity and effort was somewhat strained. Moreover, it was becoming increasingly apparent that the workers responsible for the measurement of college students were not primarily interested in measuring native mental ability free from the effects of environment; they were engrossed in the problem of prediction of success in college. Only a few general mental tests in the older tradition have been found useful in prognosis of college success. The recent Scholastic Aptitude Test of the College Entrance Examination Board constitutes a selection of the army type sub-tests which may be expected to yield the maximum results obtainable with such tests. Its title is significant, and its authors point out explicitly that it may or may not measure "general intelligence," but that "there is a tendency for individual differences in scores in these tests to be associated positively with individual differences in subsequent academic attainment." It is the opinion of the present writer that this test marks the end-point of development of the general psychological examination for college entrants: the time has come for new theories and new methods. . . .
>
> The [Iowa Placement] examinations cover the following subjects: English, mathematics, chemistry, physics, French and Spanish, each being represented by two series (with two forms for each test): an Aptitude Examination which measures those particular mental abilities which are related to subsequent success in the subject, and a Training Examination which is primarily a standardized achievement test of sufficient scope and difficulty to be used at the college level. The Aptitude Examinations are closest to the usual mental ability test, but they do not hesitate to draw on learned material which is an essential preliminary to the work at hand. Thus an

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[1] Stoddard, George D.: Iowa Placement Examinations — A New Departure in Mental Measurement. *Psychological Monographs*, 1928–1929, 39, No. 2, 92–101.

> arithmetic section is found in the Chemistry Aptitude Examination, while reading ability is measured throughout the series. Two examinations, Mathematics Aptitude and Foreign Language Aptitude, will suffice to illustrate the concept of "aptitude for a subject" which has been incorporated in the Iowa tests. The first consists of measures of the ability to complete arithmetic and algebraic number series, to solve original problems involving spatial imagination, to succeed with symbolic logic, and to comprehend new and difficult mathematical reading material; the second measures knowledge of English parts of speech, inflections, and roots, transfer of training from English to an unfamiliar language (Esperanto), skill in grammar principles, comprehension, and translation in a strange language (Esperanto).
>
> The Training Examinations were validated in the usual manner, and serve as reliable, objective measures of high school performance in the subject. In the aggregate they constitute a much better estimate of the secondary school work of the students in the field tested than is given by school marks. (pp. 92, 94-95.)

Massive data accumulated over the past fifteen years show a substantial relationship between test-score and college performance in the fields covered by the Iowa tests. It is clear from the content of these tests that reading comprehension, utilizing the subject matter characteristic of a field, carries a heavy weight. In foreign language aptitude, the ability to manipulate and understand linguistic relationships in Esperanto has a carry-over to analogous abilities in French, Spanish, and German. While most students are unfamiliar with Esperanto as such, it is obvious that a knowledge of language structure would be helpful in deciphering the Esperanto. Since the latter ability is in itself related to the probability of success in a foreign language, there is no loss in test validity. Similar techniques have been employed by Ferson and Stoddard in the measurement of law aptitude,[1] by Moss in medicine,[2] and by Mann in engineering abilities.[3] Overlapping will characterize all these aptitudes to the extent that common factors are discoverable for the different academic and professional demands. Since the intellectual demands in a field may shift somewhat, aptitude tests should be constantly revised.

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[1] Stoddard, G. D.: Ferson and Stoddard Law Aptitude Examinations - Preliminary Report. *American Law School Review*, 1927, 6, 78–81.

[2] Moss, F. A.: Scholastic Aptitude Tests for Medical Students. *Journal of the Association of American Medical Colleges*, 1933, 7, 129–148.

[3] Mann, Clair V.: *Objective Type Tests in Engineering Education as Applied to Engineering Drawing and Descriptive Geometry.* New York: McGraw-Hill Book Company, Inc., 1930. Pp. x, 122.

Because of the validation of Binet tests in terms of the quality of school performance, the relation of aptitude testing to Binet testing is closer than might have been suspected. A Binet test-item is a task that parallels scholastic success. Essentially it is little more than this. Aptitude examinations are not directly related to an increase in chronological age, although they would be, if extended downward into the high-school and elementary-school years. The items in these tests are validated in terms of the differential performance of students who fail and students who succeed in the subject matter for which the aptitude is presumed to be prerequisite. A convergence of common aptitudes, let us say of reading comprehension in a half dozen fields, would be, for the adult mind, an improvement over Binet testing, but in view of the presence of overlapping not explicitly analyzed and measured it would form a wasteful composite. Hence the need at the adult levels is for the measurement of knowledge and learning aptitudes. A concomitant need is for the construction, from the ground up, of new tests available throughout childhood and the highest abstract levels of adulthood. These tests should embody the most economical composite of the attributes described in Part I.

Guiding Principles

There is a general principle that should be given a trial in any attempt to formulate testing in relation to the attributes of intelligence. It may be called the principle of *triple testing*, as follows:

Stage 1. A diagnostic test for knowledge of the fundamental operations involved and of reading comprehension at or above the wording of the test and its directions.

Stage 2. For various sections or levels of knowledge, a test of the new abstractions and operations demanded (given certain mental "bricks," what kind of structure can be erected?).

Stage 3. A test of the limits of intelligence, involving three kinds of subtests: (*a*) tests at the top levels of the attributes, for example, in tasks for which a subject has a clear grasp of the units, but is finally stopped by a succession of derivative relationships; (*b*) tests of originality whose products will not be scored by a key but by a conference of judges; and (*c*) tests of the resistance to the strongest forces of suggestion and irrationality available within the practical limits of testing.

Intelligence as measured is based on a heterogeneity of previous experience, although the assumption is made that experience has been about the same for all children. In our new formulation, it is important to note that *the idea is not to equate past experience but to arrive at a measure of intelligence.* That portion of experience which has affected mental ability should not be ruled out.

While all mental ability is inferred from achievement, it does not follow that any kind of achievement will give a clew to the ability factors. Ability should not be spelled with a capital letter; it is not *Something* that does something. It is a logical derivative from certain limited observations; it is no organ of the body, but a construct of language.

Intelligence tends to feed on its own experiential past. Since intelligence grows over a period of many years, some relationships may have become habitual. They were formed at immature levels. What the child has learned at six, he keeps for sixteen: hence the importance of early learning, relearning, and remodeling. This calls for flexible learning in certain areas such as social relationships, while permitting overlearning to be carried on in mathematics, and to some extent in the physical sciences.

The delaying of a reaction is the essence of the intelligent act, but if carried to extremes, it may lead to mental confusion. Not only do facts and relationships change, but the whole problem evolves. In this phenomenon can be seen the desirability (perhaps the sheer necessity) on the part of the organism to tack down something, if not too tightly. Much depends on the meaning attached to the concepts "hypothesis" and "solution." In a scientific world devoid of final solutions, everything is hypothesis or probability. We could call our hypotheses solutions, if in so doing we were not tempted to avoid their revision or discard.

As we go up through the later years of childhood and into adulthood, it will be seen that the mental field becomes somewhat compartmentalized. Hence the adequate adult intelligence test, when it arrives, will consist of both a general pool of mental abilities and tests of special aptitudes. To get a high rating any person ought to see through "false logic," if it is presented in common terms, but to spot egregious errors in mathematics or chemistry will take a person with special training. Since a portion of one's adult abilities (for many, the highest expressions of these abilities) will now appear in special fields, these must be tapped. The chemist's intelligence must be measured in part in chemistry, the mathematician's in mathematics, the mother's in child care, and the lawyer's in legal concepts. Not all special areas could be developed in test forms — perhaps fifty would suffice. In any case, the person tested would be given a choice in selecting the second part of his intelligence test.

The adult mental test could be constructed along these lines:

A. *General Tests of Adult Intelligence*

(1) Tests of general comprehension.
(2) A logic test.
(3) A test of plasticity (learning and retention of new materials).
(4) A test of concepts of personality and behavior.
(5) A test of concepts of social responsibility.

(All the five areas listed above should be made consistent with the definition of intelligence given in Part I.)

B. *Special Tests of Adult Intelligence* (Illustrative Items)

(1) Advanced reading comprehension.
(2) Concepts in mathematics and the physical sciences.
(3) Concepts in the life sciences.
(4) Concepts in the social sciences.
(5) Concepts in the fine arts.
(6) Concepts in the humanities.
(7) Concepts in applied arts, crafts, and vocations.

The tests in Part B are regarded chiefly as knowledge tests revealing certain aptitudes. The fields represented are so broad as to necessitate considerable subdividing in actual practice. The tests should be based on certain essential relationships, principles, and discoveries in these fields.

A subtest (based on Langdell) in the *Ferson-Stoddard Law Aptitude Examination* would be appropriate under B(1) above. A knowledge of language but not of law is a prerequisite.

What we need for adults is not a single general rating, such as mental age or intelligence quotient, but indices conforming to the attributes of intelligence. Some of these indices could be combined to form the *index of aptitude*, or IA. The IA could be based on the general tests mentioned above. They would provide tasks of increasing difficulty and complexity in fields appropriate to adult manipulations. The IA could be reported in conjunction with an *index of knowledge*, IK, in two parts: (*a*) general knowledge appropriate to adults (in the sciences, arts, and humanities) and (*b*) intensive knowledge in selected fields. While the IK overlaps the IA, it is not the same: there is room for much divergence.

Superficiality would be avoided by asking questions beyond the first obvious facts and relationships. The individual would be tested for his ability to take on new abstractions (IA) and for the richness and accuracy of the knowledge already in stock (IK). Every academic field that can be considered an extension upward of a common-school curriculum should afford items for such a test: if we had compulsory high-school and college attendance, what would be the common core of knowledge and experience we should expect of each person? From this core of materials, differing from the standard curricula of colleges, but like the first two years of a program in general education, there would be constructed a battery of appropriate tests.

An *index of stability* (IS) may be mentioned in passing. Any good test in this area would furnish clews as to the power of intrusive emotional blockings. The test, however, would not be confined to its effects upon intellectual behavior. It would seek to distinguish persons in, or headed for, neurotic and psychotic involvements from those who are stable. It is no exaggeration to say that adults high in IA, IK, and IS would be in demand in any normal society. As a group, they would still fall short of a genius rating; they would be simply able, well-informed, and well-adjusted persons. To the extent that, in less than perfect societies, some deviation in IS would condition discovery and spectacular achievement, this rating might fluctuate in its relation to the other two. However, the IA and the IK, if richly conceived with room at the top for truly original contributions, should come closer to a valid rating of genius than anything now available.

CHAPTER VI

FACTOR THEORIES

THE WORK OF THURSTONE AND OTHERS

In 1938, Thurstone[1] reported upon an experiment in which a battery of 57 psychological tests was given to 240 University of Chicago students, chiefly freshmen. These tests were loosely classified as follows:

(1) Abstraction (five tests).
(2) Verbal (eight tests).
(3) Space (nine tests).
(4) Form (four tests).
(5) Number (six tests).
(6) Numerical Reasoning (four tests).
(7) Verbal Reasoning (three tests).
(8) Space Reasoning (three tests).
(9) Rote Learning (six tests).
(10) Unclassified (nine tests).

On the whole, the subtests were designed to measure "general intelligence." For the most part they were constructed for this study. The grouping indicated above is tentative, for the main purpose of the study was to isolate *primary mental abilities*. Different abilities will be called forth in tests of the same name, if they are presented at various levels of difficulty. The factorial analysis called for in Thurstone's problem was in itself a computational feat. In view of the enormous number of *r*'s needed (nearly 1,600), tetrachoric correlations were utilized. From these, product moment correlations were estimated.

The analysis was carried out to thirteen factors. The withdrawing of the first six factors represented almost as much common-factor variance as was eventually disclosed, and there was not too much to be expected after withdrawing the first three factors (labeled *spatial, perceptual,* and *numerical*). Using a centroid system of analysis (the primary factors being regarded as either zero or plus), Thurstone rotated the axes in order to avoid negative projections and to maximize the number of zeros. Primary factors were envisaged as orthogonal in their geometric interrelationships. Thurstone's tentative designation of factors follows:

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[1] Thurstone, L. L.: *Primary Mental Abilities*. (Psychometric Monographs, No. 1.) Chicago, Ill.: University of Chicago Press, 1938. Pp. ix, 121.

S Spatial
P Perceptual
N Numerical
V Verbal Relations
M Memory
W Word Fluency
I Induction
R Restriction
D Deduction

Factors 10, 11, 12, and 13 may be regarded as obscure. Test-items, to be considered meaningful in their contribution to the concept of a common element, were required to have a factor loading of .40 or above, but there were few such entries in the last four columns in the matrix. (This prerequisite indicates that the factor in question will account for at least 16 per cent of the total variance of the test.)

The common factor S (Spatial) may be used as an example. The following tests made projections as indicated:

(6)	Verbal Classification	.411
(8)	Figure Classification	.393
(17)	Block-counting	.413
(18)	Cubes	.626
(19)	Lozenges A	.448
(20)	Flags	.636
(21)	Form Board	.415
(22)	Lozenges B	.633
(23)	Surface Development	.551
(27)	Pursuit	.584
(45)	Syllogisms	.430
(53)	Hands	.455
(55)	Sound-grouping	.412

Here, as elsewhere, it is hard to guess why some tests make the contribution they do. Thus Test 55 is a test of sound-grouping in which auditory factors are presented in a paper and pencil test. The directions read as follows:

> In the line below, notice that the three words, *comb*, *foam*, and *home*, can be grouped together because they sound somewhat alike. The word *come* does not belong with the other three because it sounds different. Since *come* is the fourth word, *4* has been written in the blank at the right.
>
> 1 — comb 2 — foam 3 — home 4 — come *4*
>
> Three of the words in the line below belong together because they sound alike, while one of the words does not belong because it

> sounds different. Write the number of that word in the blank at the right.
>
> 1 — praïse 2 — chase 3 — maize 4 — phase .... —
>
> The word *chase* does not belong with the other three. You should have written *2* in the blank. (p. 56.)

Similarly, Thurstone questions why certain tests do not display this factor. For example, Test 25, Mechanical Movements, is a test of "kinesthetic imagery" in which the subject is expected to see the direction of motion for various mechanical parts graphically presented.

In some cases a further check on the validity of the naming of factors might come through the determination of sex differences. Since Thurstone used only men in his experiment, this was not feasible. In general, as we move away from the first three or four factors, the difficulty of naming increases, and throughout the series it is not clear what the psychological significance may be. To quote Thurstone:

> The fact that occasional feeble-minded individuals possess some degree of number ability indicates further that it constitutes a more or less independent mental ability. Of interest for this problem is the frequent occurrence of considerable mental ability in the verbal factors combined with what seems to be a blind spot for numerical and logical relations. (p. 83.)

Judging from other testing programs, it is here that we might discover the sex differences mentioned above. Perhaps there is implied a choice of medium with respect to intelligent behavior. Unless the choice is made and developed over the years, the ability may be reduced relatively to the test performance of other individuals. In this sense some abilities may be designated competitive or counterabilities. Whatever a primary ability turns out to be, it will in all likelihood change with variations in the following: (1) difficulty of the test; (2) age of the subjects; (3) mental age of the subjects; (4) practice effects; (5) reliability of the tests; (6) the sampling available; and (7) the requirement of speed. All these considerations lead to a preference for a characterization such as *semi-independent achievement* or, at the most, *semi-independent ability.*

Thurstone has given a compact summary of his important experiment:

> Ideally, we should not be satisfied until the factorial description of a test remains invariant when it is moved from one test battery to another. If a test demands the functioning of several factors in certain proportions, then, surely, it does not make sense if these factorial components are completely altered merely by asking the same subjects to take additional tests next week. By so doing, we add new tests to the battery and we alter the principal axes and the principal components of the tests. These axes are determined by the battery as a whole. This is an absurdity. We cannot, then, make any claim that the factors are unique and psychologically meaningful traits of the individual subjects. My own first efforts in factor analysis involved this absence of psychological uniqueness, and I therefore discarded the principal component description of the tests even though the solution was mathematically unique within each test battery. The solution which I have found for this problem is to rotate the reference frame into a simple structure if it exists in the battery. The factorial description of each test is then independent of the fact that the tests are assembled in a particular battery. To increase the number of verbal tests or to withdraw some spatial tests, for example, has no effect on the reference frame for a simple structure. This type of invariance gives the possibility of identifying the reference axes in terms of unique traits of the individual subjects. (pp. 90–91.)

Thurstone feels that a search for primary mental abilities would not be helped by attempts to get higher validity, that is, higher correlations between a battery and a criterion such as academic marks. Rather he feels that improvement must come through a purifying of the tests, perhaps along the lines employed in the Seashore pitch test. (It has been shown lately that the pitch test calls for different abilities at different levels of discrimination.) This throws us back upon the meaning of intelligence. Factorial analysis appears helpful in answering this question: What are the major and somewhat independent abilities involved in the great inchoate composite that has been styled *intelligence test* or *mental test battery?* It cannot answer the further question as to which tests and abilities most closely conform, along theoretical and practical lines, to a concept of intelligence already laid down.

Bernreuter and Goodman[1] applied Thurstone's experimental edition of Primary Mental Abilities tests to 170 freshman engineering students comprising a good sampling of the freshman class at Pennsylvania State College. These students represented an upward selection from their high-school graduating classes. Reliabilities of the subtests, computed by the Spearman-Brown formula, varied from .75 to .98, with a mean of .93. All the intercorrelations among the primary abilities were positive but low, the median being .24. In the prediction of semester marks in each of three major subjects, chemistry, English composition, and mathematics, a multiple correlation of .49 was obtained. None of the primary abilities predicted engineering drawing, the perceptual factor correlating $r = .00$. Prediction of semester marks by means of any one primary ability ranged from $r = .04$ (for P) to $r = .38$ (for D), the latter correlation equaling that reached by DeCamp's Pennsylvania State College Psychological Examination.

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[1] Bernreuter, Robert G., and Goodman, Charles H.: A Study of the Thurstone Primary Mental Abilities Tests Applied to Freshman Engineering Students. *Journal of Educational Psychology*, 1941, 32, 55–60.

Reyburn and Taylor[1] report an extensive study based on 1,497 Transvaal school children, about half of them English-speaking. The ten tests were Binet in type (form boards, digits forwards, digits backwards, visual perception, absurdities, mazes, arithmetic, reasoning, vocabulary, and dissected sentences). Thurstonian methods applied to their factorial matrix yielded five factors. They proved rather hard to identify. None of the factors could be designated as a general factor, although two factors were found to be common to five tests and three group factors were tentatively located. There was evidence for the appearance of factors which could be designated *memory, verbal fluency,* and *manipulative fluency.*

Crawford,[2] referring to Thurstone's work and to a report by Shanner,[3] questions the specificity of the primary abilities. His observations are based on the sixteen experimental tests for seven primary abilities published in 1938 by the American Council on Education. He calls attention to substantial intercorrelations, such as .50 for perceptual-number, .61 for perceptual-verbal, and .49 for perceptual-spatial. Considering test unreliability, and the restricted range of talent of the subjects, he regards these correlations as substantial. (It must be said, however, that the mere fact of substantial intercorrelation does not necessitate a lack of identity for a factor.) He objects to any attempt to average such intercorrelations. Crawford comes to the conclusion that the primary abilities are really "secondary abilities," since they are affected by educational experience and other external factors; they are not something given to the individual and grown within him as a psychological reality.

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[1] Reyburn, H. A., and Taylor, J. G.: Some Factors of Intelligence. *British Journal of Psychology (General Section),* 1941, 31, 249–261.

[2] Crawford, A. B.: Some Observations on the Primary Mental Abilities Battery in Action. *School and Society,* 1940, 51, 585–592.

[3] Shanner, William M.: A Report on the Thurstone Tests for Primary Mental Abilities. *Educational Record Bulletin,* 1939, No. 27, 54–60.

Stalnaker[1] made a study of the results of administering the American Council primary abilities tests to the freshmen entering the University of Chicago in 1938. The correlations presented are based on the scores of 421 boys and 252 girls. For the tests which were utilized to yield the score on a given primary mental ability, these coefficients ranged from .20 to .79, with a mean of .49; correlations among tests not used in support of a single ability ranged from −.07 to .49, with a majority below .20. Stalnaker indicates that the factor of speed was of great importance throughout the battery, although this is not recognized as a primary ability. For this group of subjects, extension of the time allowed for each test might have altered the factorial composition disclosed.

In a further investigation, Thurstone and Thurstone[2] have extended the study of primary abilities downward to younger subjects and have made a special study of the word-fluency factor *W*. On this factor *W* they comment:

> The word-fluency factor *W* is also one of the most clearly defined primary mental abilities. It is involved whenever the subject is asked to think of isolated words at a rapid rate. It is for this reason that we have called it a "word-fluency factor." It can be expected in such tests as anagrams; rhyming; producing words with a given initial letter, prefix, or suffix; or writing words in a given category, as boys' names or things to eat and drink. Any task in which the verbally fluent person has an advantage should involve this factor, which is clearly distinct from the verbal-comprehension factor.

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[1] Stalnaker, John M.: Primary Mental Abilities. *School and Society*, 1939, 50, 868–872.

[2] Thurstone, L. L., and Thurstone, Thelma Gwinn: *Factorial Studies of Intelligence* (Psychometric Monographs, No. 2). Chicago, Ill.: University of Chicago Press, 1941. Pp. v, 94.

> These two verbal factors are, however, correlated. Whether the correlation is in some way intrinsic is a question that cannot yet be answered. It may be that we do not yet have any tests in which one of these factors is present while the other is absent, or it may be due to the existence of two associated but distinct parameters in the processes involved in verbal intelligence. Tests of the sort that we have found for this factor have also been used by some investigators as tests of temperamental qualities. It is not unlikely that the word-fluency factor is indicative of some temperamental traits in addition to its cognitive implications. If such double interpretations can be sustained, they will serve to break down the conventional differentiation between intellectual and temperamental parameters, which are probably much more interwoven than we have supposed. (p. 3.)

A difference between *W* and *V*, the verbal-comprehension factor, is shown by means of the ordinary recognition vocabulary test which has a high saturation in verbal-comprehension and scarcely any in word-fluency. A free-recall synonyms test, in which any three common synonyms could be written for a given word, was high in *W* and lacking in *V*.

The Thurstones' judgment is that the primary factors, which may now be represented in a battery of tests with a reliable set of subtests for each primary ability, are the following:

V Verbal-comprehension
W Word-fluency
S Space
N Number
M Memory
I Induction

None of these factors is considered as fixed, indivisible, or noncombining; each one is dependent for its validity on the nature of the tests and of the population examined. But each primary ability "behaves as a functional unit, that is strongly present in some tests and almost completely absent in many others." In the present study, the Thurstones prepared a battery of tests suitable for the fourteen-year age level, utilizing all previous tests that seemed appropriate. Altogether 1,154 children were tested in the eighth grade of 15 Chicago elementary schools. To give the sixty tests, required eleven one-hour sessions. The factorial analysis was based on the 710 subjects who took all the tests.

For the six factors *V*, *W*, *S*, *N*, *M*, and *I*, which seem most readily identifiable, the Thurstones have computed the correlations among the primary abilities and come to the conclusions quoted below. Perhaps their statement will do much to resolve the long-standing controversy as to how human abilities may be taken apart and put together again:

> The single factor loadings show that the verbal factor has the highest loading and the rote-memory factor the lowest loading on the common general factor in the primary abilities. This general factor is what we have called a "second-order general factor." It makes its appearance, not as a separate factor, but as a factor inherent in the primaries and their correlations. If further studies of the primary mental abilities of children should reveal this general factor, it will sustain Spearman's contention that there exists a general intellective factor. Instead of depending on the averages or centroids of arbitrary test batteries for its determination, the present method should enable us to identify it uniquely. We have not been able to find in these data a general factor that is distinct from the primary factors, but the second-order general factor should be of as much psychological interest as the more frequently postulated, independent general factor of Spearman. Our findings seem to support Spearman's claim for a general intellective factor, but he has been so critical of our work on the primary mental abilities that it is uncertain whether he would accept our support for a general intellective factor. We have not found any occasion to take sides as regards the existence of a general intellective factor. Our factorial methods are adequate for finding such a factor, either as a factor independent of the primaries or as a factor operating through correlated primaries. We have reported on primary mental abilities in adults, which seem to show only low positive correlations except for the two verbal factors. Here we find higher correlations among the primary factors for eighth-grade children. It is now an interesting question to determine whether the correlations among primary abilities of still younger children will reveal, perhaps even more strongly, a second-order general factor. (p. 26.)

However, as the Thurstones remark subsequently, following a second analysis based on twenty-one selected tests, it is still too early to say much about the relationship of a general factor to the primary factors discovered in the tests. To the extent that the primary mental abilities show genuine, if low, intercorrelations, there is a basis for postulating some kind of general factor. At the present writing it seems doubtful that these correlations will disappear. Also the tendency for the entries in a factorial matrix to be low (the infrequent factor loading of .70 is needed to gather in half the variance of a test), even when the tests have been purified, gives further evidence as to the relativity of the concept of primacy or independence.

The general problem in the analysis of primary mental abilities is to discover the separate factors in a mixture or composite, followed by an attempt to measure the areas, traits, or abilities that are thus identified. In the words of Thurstone:[1]

> The object of factor analysis is to discover the principal dimensions or categories of mentality and to indicate the directions along which they may be studied by experimental laboratory methods. Factor analysis is not restricted by assumptions regarding the nature of the factors, whether they be physiological or social, elemental or complex, correlated or uncorrelated. It assumes that a variety of phenomena within the domain are related and that they are determined, at least in part, by a relatively small number of functional unities, or factors. The factors may be called by different names, such as causes, faculties, parameters, functional unities, abilities, independent measurements, experimentally independent effects. The name for a factor depends on the context, on one's philosophical preferences and manner of speech, and on how much one already knows about the domain to be investigated. The factors in psychological investigations are not ordinarily to be thought of as elemental things which are present or absent, like heads or tails in the tossing of coins. (p. 189.)

It is unnecessary to postulate a single common factor, but only to build up a method of isolating individual factors, if they exist. If many tasks or tests contain in the aggregate a smaller number of abilities, factorial analysis will disclose this structure. As Thurstone says, it is absurd to postulate, as in the early days of psychology, a "faculty" for everything that can be observed or measured; there must be some generalizing principle if the process is to have meaning. In the correlational matrix consisting of rows of tests and columns of abilities, the entries will show a relation between factors and tests. This matrix is factored by finding the lowest number of factors that will account for all the correlations. Since some tests will not require all the factors or abilities, there will be zero entries. This condition permits the selection of the most meaningful solution. Any factor that appears in more than one test is regarded as a common factor. Similarly, once geometric axes of relationships are established, the axes can be rotated without doing violence to the matrix relationships. This process helps to solve the problem of selection. Thurstone does not hold that all primary factors have the same source:

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[1] Thurstone, L. L.: Current Issues in Factor Analysis. *Psychological Bulletin*, 1940, 37, 189–236.

> Some of the primary factors may turn out to be defined by endocrinological effects; others may be defined in biochemical or biophysical parameters of the body fluids or of the central nervous system; other primaries may be defined by neurological or vascular relations in some anatomical locus; still others may involve parameters in the dynamics of the autonomic system; still others may be defined in terms of experience and schooling. (p. 203.)

The observations of Seashore, Buxton, and McCollom,[1] based on a series of motor tests, indicate that a sense modality or a particular physiological conformation is not required as a basis for independent factors. Utilizing tests of simple reaction time, simple tapping rate, complex tapping rate, serial high speed categories, postural steadiness, form boards, and assembly tests of mechanical abilities, and as subjects, fifty students in a psychology course, they isolated six factors as follows:

(1) Speed of single reaction.
(2) Finger, hand and forearm speed in restricted oscillatory movements.
(3) Forearm and hand speed and oscillatory movements of moderate extent.
(4) A group factor emphasizing steadiness and precision.
(5) Skill in manipulating spatial relations.
(6) Residual.

They conclude:

> The factors isolated in this study are found to correspond more to *qualitative similarities in the pattern of action*, including perceptual activity, involved in various tests rather than to anatomical units such as the dominant sense-field or even the musculature employed. In keeping with previous experiments as summarized by Seashore, we find that shifting from one musculature to another makes very little relative difference in performance, while keeping the muscu-

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[1] Seashore, R. H., Buxton, C. E., and McCollom, I. N.: Multiple Factorial Analysis of Fine Motor Skills. *American Journal of Psychology*, 1940, 53, 251–259.

> lature constant and shifting to another pattern of action makes a great deal of difference in the correlations. With the exception of Factor IV (steadiness), our factors include such narrow groupings of performances as to make application to the prediction of complex practical skills a hazardous undertaking, a result which is corroborated by our industrial experiments to date. (p. 258.)

Guilford[1] doubts that an analysis of tests will reveal the most important factors, inasmuch as the possession of any human ability below the threshold established by differential testing does not yield a test of the factor. Thus a speed factor will be masked unless speed of performance is a genuine variant in both the ability of the population and the requirements of the test. Learning itself is not easily generalized. The observations of Woodrow [2] and Guilford [3] pointing out the types of specificity in learning, were predicted in some early work of Ruch [4] and Stoddard [5] which emphasized differences in learning arising from different degrees of abstraction.

THE VIEWS OF THOMSON AND SPEARMAN

Thomson [6] is dubious about the chances of bridging the gap between statistical exploration and psychological reality:

> In general, simple structure will be attainable with a battery of tests only when the battery has been picked with that end in view. There is a certain incompatibility about Thurstone's demands which makes their fulfillment only possible in special circumstances. He wants as few common factors as possible to explain the correlations; but he wants these common factors to have no loadings in a large number of the tests. This is rather like wanting to run a school with as few teachers as possible, but each teacher to have a large number of free periods. If we begin by reducing the number of common factors to its minimum (as Thurstone does), we will generally find that the second requirement cannot be fulfilled. It can, however, be fulfilled in some cases, and it is exactly these cases which Thur-

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[1] Guilford, J. P.: Human Abilities. *Psychological Review*, 1940, 47, 367–394.

[2] Woodrow, Herbert: The Application of Factor-Analysis to Problems of Practice. *Journal of General Psychology*, 1939, 21, 457–460.

[3] *Op. cit.*

[4] Ruch, Giles Murrel: Correlations of Initial and Final Capacities in Learning. *Journal of Experimental Psychology*, 1923, 6, 344–356.

[5] Stoddard, George D.: The Problem of Individual Differences in Learning. *Psychological Review*, 1925, 32, 479–485.

[6] Thomson, Godfrey H.: *The Factorial Analysis of Human Ability*. Boston, Mass.: Houghton Mifflin Company, 1939. Pp. xv, 326.

> stone relies on to define his primary factors. It is his faith that factors found in this mathematical way will turn out to be acceptable to the psychologist as psychological entities. (pp. 265–266.)

Commenting on the disappearance of *g* from Thurstone's analysis of factors, Spearman[1] says:

> . . . the new operation consisted essentially in scattering *G* among such numerous group factors, that the fragment assigned to each separately became too small to be noticeable. . . .
>
> The suggestion arises that few if any of the new unverified, and even unintelligible, factors are anything more than statistical artifacts. . . .
>
> In opposition to the claim of any such factors to be "primary," the theory of two factors would say that they really represent nothing more than those constituents of the tests with respect to which two and more of them happen to overlap. And all such overlapping (save in the case of *G*) depends altogether on which tests may happen to have been put together. By this and other considerations we are led to the view that group factors, far from constituting a small number of sharply cut "primary" abilities, are endless in number, indefinitely varying in scope, and even instable in existence. *Any* constituent of ability can become a group factor. *Any* can cease being so. Science can do no more than pick out those of them which happen to have or acquire sufficient breadth of scope to make their study worth while. (pp. 14–15.)

After pointing out that standard mental testing, Binet in type, has certain theoretical and structural defects arising from its dependence on memory, from the composite nature of the tests, and from the differential experience required for passing the subtests, Spearman[2] holds that all these matters can be resolved by turning to his theory of two factors. To quote:

> From all these defects in the current methods of testing intelligence, let us turn to another method that claims to overcome them. It has been designated as that of Two Factors. Its essential nature consists in splitting the score of the subject at any test (or sub-test) into two independent parts, of which the one, "G," is quite general, whereas the other, "S," is narrowly specific. Here, it is said, the fatal equivocality vanishes. For G has been shown to measure a perfectly definite mental power: this may be roughly described as that of originative thinking in contrast with merely sensing or

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[1] Spearman, C.: Thurstone's Work Re-worked. *Journal of Educational Psychology*, 1939, 30, 1–16.

[2] Spearman, C.: "Intelligence" Tests. *Eugenics Review*, 1939, 30, 249–254.

> reproducing. More precisely, the process has been designated as "eduction" and has been shown to take two sharply distinguishable forms. In one, the person sets out from two or more items of knowledge and goes on to perceive how these are mutually related. For instance, he might hear and understand the words "good" and "bad," which qualities he should then perceive to be "contrary" to one another. In the other form of eduction, the person starts from any item of knowledge together with some appropriate relation, and thence conjures up to mind the other item so related to the first one. For instance, he might somehow be given the ideas "good" and "contrary to," and thence he should derive the further idea of "bad." In these two forms of eduction, it is asserted, are comprised the whole and nothing but the whole of genuine insightful knowledge. (p. 250.)

Spearman then illustrates his point by clinic materials prepared by Line, Raven, Penrose, and others, indicating that measurements based on his theories of eduction are reliable, highly correlated with "G," and saturated with high abstracting ability. Nevertheless all these tests must be considered as fragments. They do not as yet provide a satisfactory measuring scale of wide range, standardized in terms of the probable mental demands upon children and adults. The actual construction and validation of tests carrying out the ideas of Spearman and his later associates, and implementing the theories contained in Spearman's *Nature of Intelligence and the Principles of Cognition* (1923) and *The Abilities of Man* (1927), awaits the willing worker. Perhaps, if attempted, this program would look disconcertingly like Binet (extended and revised) — *plus ça change, plus c'est la même chose!*

A need for some kind of analysis of mental ability is expressed by Thomson[1] who has long advanced a sampling theory to account for the findings of Spearman, Thurstone, and their associates. He believes that "the mind works *as if* it were composed of these hypothetical factors, *g*, *v*, *n*, etc., and a number of specific factors." The laws involved are not psychological, but statistical. While the complexities of the ordinary schoolroom may exceed the demands of mental tests, Thomson does not follow Thorndike in postulating more connections to account for this; the difference lies in the patterns formed. Still, Thomson visualizes the mind as "a rich, comparatively undifferentiated complex of innumerable influences." Since natural selection favors positive correlations and organic growth patterns that are mutually consistent, there emerges, as a descriptive phenomenon only, a general factor. The concept of *g*, then, refers to the "whole mind," while other common factors measure subpools, or the "degree of structure."

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[1] *Op. cit.*

> Some of this "structure" is no doubt innate; but more of it is probably due to environment and education and life. Its expression in terms of separate uncorrelated factors suggests what is almost certainly not the case, that the "sub-pools" are separate from one another. The actual organization is likely to be much more complicated than that, and its categories to be interlaced and interwoven, like the relationships of men in a community, plumbers and Methodists, blonds, bachelors, smokers, conservatives, illiterates, native-born, criminals, and school-teachers, an organization into classes which cut across one another right and left. No doubt these too could be replaced, and for some purposes replaced with advantage, by a smaller number of uncorrelated common factors and a large number of factors specific to plumbers, smokers, and the rest. But the factors would be pure figments. (p. 284.)

THE CROSSROADS

And so we come to the crossroads in a different sense from Kelley's usage of the term. Kelley[1] believes (p. v) "that a method of proving the independence of two or more mental traits or capacities lies at the root of a comprehensive study of mental organization." We see that the quest for isolation may be another will-o'-the-wisp. Wherever physiological ontogeny is at the root of the differences, some independence can be found, even though the organism utilizes all its parts and senses in a cross-connected pattern. Through seeing and hearing, the child will develop visual and auditory abilities, together with combinations of experiences, aptitudes, and achievements springing from both types of sense data. That visual imagery can be completely barred, as in the congenitally blind, does not mean that a later blindness, or a shutting of one's eyes, will establish independence among sensory data.

When we come to such complexities as language and creative work, all we can hope to arrive at is a measure of focus, habit, and suitability. We cannot get together by statistical methods what the human mind chooses to accept as different, verifying its choice in terms of usage; we cannot separate the inseparable. That every ability which can be named and measured differs in some respect from any other ability or any aggregate of abilities is axiomatic. While it is not demanded logically that every mental ability be related to other mental abilities, thus forming a basis for a common pool or factor, this phenomenon is characteristic. There is a likelihood that a person high (or low) in one mental aptitude will be high (or low) in another; there is a further likelihood that the upward ranging of intelligence in the individual will be related to the quality of the foundation capacities, although these alone, without high-order integration, may carry him through the top levels of existing intelligence tests. This provides a basis for indeterminism at the genius levels.

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[1] Kelley, Truman L.: *Crossroads in the Mind of Man: A Study of Differentiable Mental Abilities.* Stanford University, Calif.: Stanford University Press, 1928. Pp. vii, 238.

While it need not be said that factors are statistical fictions, if by such a term we mean something unreal or futile, it is clear that the actual determination and interpretation of the factors in mental tests is a difficult process. Where the underlying definition is clean-cut, we may expect a functional unit that will emerge into meaningfulness, as in verbal, number, and spatial relations. But abilities need not be together in any physical or physiological fashion in order to constitute a psychological or social nucleus which could be described as a factor. Physiological or sensory processes are not themselves reliable in identifying the basic structure of *mental* abilities. If we were to go along with Thorndike in postulating countless bonds or minute elements of ability, or with Thomson in postulating also pools and subpools (or any type of integrative process), we could still say that clustering indicates a factor.

When all the influences upon factors that may cause them to wax and wane are thought of together, they act as a depressant upon anyone whose expectations have been high. No one need question the excellence of the mathematical, graphic, and theoretical work, combined with clarity and objectivity in the reporting of results, displayed by Thurstone and his contemporaries. The difficulty lies in the practical application of these methods to problems in the understanding and measurement of intelligence. Nothing is fixed; in the human organism everything changes, grows, and deviates, and, in a succession of individuals, becomes a part of the evolutionary process. In the midst of this flux, the conceptual framework of factor analysis involves an attempt to achieve order out of the opportunism of mental testing — to get away from the casual, the overlapping, and the fragmentary. If the results to date have not been striking, we should do well at least to remain hopeful.

PART III

GROWTH IN INTELLIGENCE

CHAPTER VII

CHARACTERISTICS OF MENTAL GROWTH

We shall turn now to an analysis of growth patterns and to changes in intellectual rating, without special reference to the causative influences at work. The main attack on these problems has been through retesting and observation over short or long periods. What is demonstrated is the expected course of events in the absence of a controlled environment.

LIMITATIONS OF MEASUREMENT

The limitations of definition and measurement, already described, will be seen to permeate the discussion. Even along the lines of physical growth, the problem is not simple. We can secure accurate measures of weight and height from birth to maturity, and we can convert these measures into comparative reports by utilizing centiles or standard scores. But the meaningfulness of anatomic growth is not entirely a derivative of such units. A bone may elongate or a joint enlarge itself, while the tissues that take part in these changes are showing deterioration. Measures of quality and of normality must take into account a complex set of physical and chemical processes. Since *physical growth* always involves *development*, the two terms may be considered interchangeable. There is no such thing as growth solely in one dimension.

For growth in intelligence, the problem is complicated from the start. The defects of present-day testing, as outlined previously, act as a deterrent to studies in the pattern of mental growth. The various portions of mental tests have not been separately validated over long age ranges in order to provide raw or derived scores for particular aptitudes and abilities. In fact, such an important and generally employed test ingredient as vocabulary has been little understood. Prior to the work of

Seashore[1] on vocabulary, educational psychologists greatly underestimated the vocabularies of children and adults, and it may be that the Seashore estimates will require revision upwards. Hartmann,[2] for example, believes that such an outcome is likely.

We have seen, too, that the contents of mental tests change markedly from one revision to another, not only with respect to the age placement of various items, but through the addition or deletion of materials. Above all, the standardization procedure in intelligence testing obscures the width of the steps that separate one mental performance from another; a year's growth from chronological ages three to four is not the same as a year's growth from chronological ages thirteen to fourteen. In short, we enter an abstract world in which a test unit is not a test unit, a measurement is not a measurement, a norm is not a norm, a year is not a year, an IQ is not an IQ — searching hopefully for minor clews as to intellectual maturation! It is small wonder that every study boggles that tries to answer questions like these: Is there an acceleration in mental growth? Do mental growth curves tend to parallel those for physical growth? When does mental growth cease?

The theoretical and practical difficulties that arise when measurements are applied to *behavior* (with special reference to its origins) will be treated more elaborately in Part IV (on heredity and environment). For the present, a statement in capsular form may suffice.[3]

> The mental tester, whatever his theoretical position, faces the practical necessity of measurement in terms of verbal instruction. His test items are highly saturated with differential experience and education. In the twentieth century, a population is likely to be heterogeneous with respect to race, family background and education. The organic differences that are present long before birth cannot be isolated by a social device. These differences do not stem from a single source, but vary from the predominantly innate

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[1] Seashore, Robert H., and Eckerson, Lois D.: The Measurement of Individual Differences in General English Vocabularies. *Journal of Educational Psychology,* 1940, 31, 14-38.

[2] Hartmann, George W.: A Critique of the Common Method of Estimating Vocabulary Size, Together with Some Data on the Absolute Word Knowledge of Educated Adults. *Journal of Educational Psychology,* 1941, 32, 351-358.

[3] Stoddard, George D.: Patterns of Growth in Human Intelligence. *Proceedings,* National Academy of Sciences, Washington, 1941, 27, 551-555.

> to the predominantly accidental or learned. The growing fabric of intelligence is a product of the organism's total experience. Because of certain combinations of limiting factors, there are some things the organism cannot become, but there is nothing that it must become. In order to distinguish intelligence from achievement, mental tests are often said to measure original capacity. But one sure thing about mental ability is that it grows; this being true, the word "original" becomes anomalous. One might ask, original at what time in the life history of the individual?. . . Whatever the exact form of the mental growth curve, its later stages are marked by a decline, a decline that dips into senescence if the organism survives. But a cessation of mental growth may occur at almost any age. No generalized growth curve can describe the pattern for a single individual. Some children (the idiots) grow scarcely at all; as full-grown organisms they resemble neither man nor child, but something less than either. Other children grow with such relative rapidity that they may be designated "gifted." (pp. 551–552, 553.)

The so-called basic capacities for sensory perception cannot be regarded as completely innate. Certain nutritional deficiencies will affect the mechanism for vision. Sensory differences, when measured by suitable tests, involve the acquisition of learned habits. There is nothing simple, for example, about pitch discrimination; there is evidence that this ability is susceptible to guidance and education. Similarly, capacity in tasting or smelling can be developed marvelously through experience, for it is not generally held that primitive tribes have better initial organic equipment than civilized persons who may be inferior along these lines. If asked to make the physical distinctions that are observed by students in physics, chemistry, or biology, an Indian with an extraordinary capacity to follow a path through the woods, to detect differences in wind direction, or the scents of animals, might fail: what the bacteriologist actually sees through a microscope is no direct function of his visual acuity. The eye is more than a lens; it is an extension of the brain, a true part of it.

There is no exact parallelism between concepts of physical and mental growth. While most children get the measles, a child with measles is not regarded as in a healthy or normal condition. As he goes from statistical expectation to the single child (viewed as an organization of tissues and processes), the physician unconsciously changes his point of reference: even if everybody had tumors, he would regard the tumorous condition as pathological.

MATURATION

In any discussion of mental growth, there is the recurrent question of maturation, with particular reference to the conditions under which "normal" development may take place. We must ask again the question, Can nervous tissue mature properly without external stimulation, or, if internal environment alone should be considered sufficient to cause growth, under what external conditions do the internal factors remain intact and effective? While structures to which the term *maturing* may apply are on a slow-responding rather than a fast-responding basis, maturation can be obstructed by glandular failures, nutritional lacks, or tissue destruction. Any kind of experience or environment which affects the nervous system eventually may be expected to modify the rate and character of mental growth.

At the extremes, physical and behavioral manifestations are clearly related, and we have already postulated intricate relationships at all levels of mental functioning. Lacking accurate measurements of such relationships, we can scarcely hope to build up a pattern of growth that takes them into account. We know, for example, that as the child grows, there are significant changes in respiration, circulation, metabolism, and hormonic activity. Various organs grow and decline; some take on new characteristics and a new importance. All these growth patterns are affected by external conditions. In fact, all statements about them need to be qualified by the assumption of a reasonably adequate environmental cooperation. If certain minerals and vitamins are not supplied, the so-called normal bone growth will not take place; the endocrines may not take up their proper functioning. A fundamental chemical imbalance may be responsible *in utero* for such developmental defects as epilepsy, monstrosity, and cretinism. As we view the whole organism dynamically, the wonder is that everything generally goes so smoothly, that functioning at the moment is so beautifully synchronized with the gradual filling out of the complete pattern.

A child is more than a quantitative unit in a framework of analysis. Since he represents a unique combination of factors and forces, it is necessary to extend observations beyond the statistical and the experimental into clinical procedures that reveal his individuality.

CURVES OF NORMAL GROWTH

Some of the difficulties inherent in attempting to analyze growth patterns are confronted by Freeman and Flory.[1] Their study is based on a chronological range of nine years for a selected group of boys and girls. The tests employed (in the portion of the study devoted to the growth of intelligence) comprise objective tests of vocabulary, analogies, completion, and opposites. The subjects consisted of 219 boys and 250 girls in the University of Chicago laboratory school, with an average IQ of 115. A substantial amount of material was available on the basis of repeated testing with seventy-four pupils over eight testing periods. While the reliability for the subtests was low, for the combination of the four tests, it reached the high .80's. However, the raw correlation between the composite "VACO" tests and the Stanford-Binet IQ, for a large sampling of twelve-year-old pupils, was $r = .70$. A correction for attenuation brought this figure to $r = .94$, since the reliability of the Stanford Revision for these subjects was only $r = .64$. Figure 2 shows the composite curve for all the subjects. As the authors point out:

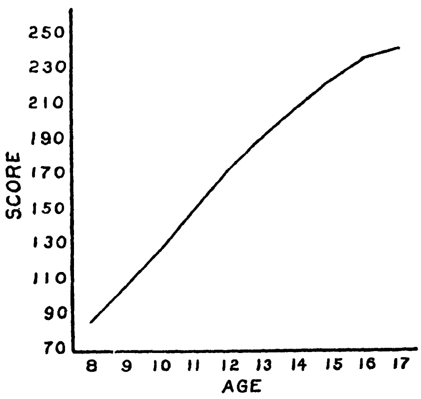

FIG. 2. The Composite Curve of All Subjects Drawn from the Mean Score for Each Age. (From Freeman and Flory, p. 29.)

> It is altogether possible that the curve has concealed some real differences. These data differ, however, from the usual cross-section data because many of the subjects were retested at successive ages. The range in retests has been shown, and it will be recalled that it varied between one and ten. More than half of the subjects had five tests, while only seventy-two pupils have had fewer than three tests. This difference from the pure random sampling method does not indicate that the curve can be taken to represent faithfully the growth curves of individuals. It does imply, however, that it comes nearer to representing individuals than do ordinary cross-section curves. Inspection indicates that the curve is not

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[1] Freeman, Frank N., and Flory, Charles D.: *Growth in Intellectual Ability as Measured by Repeated Tests.* Monographs of the Society for Research in Child Development, 1937, 2, No. 2 (Serial No. 9), pp. xi, 116.

> what is usually regarded as a typically negatively accelerated curve and that is far from parabolic. It is true that the curve tends to become somewhat less steep at the upper ages. A question may well be raised at this point concerning the influence of withdrawals and graduation on the slope of the curve. It seems rather obvious that the brighter pupils will be graduated earliest. (pp. 29–31.)

Subsequently, Freeman and Flory show that the curve for the separate tests in the VACO, while less smooth than the composite, are of the same general form. They also show that sex differences in all the tests are negligible for this sampling of pupils.

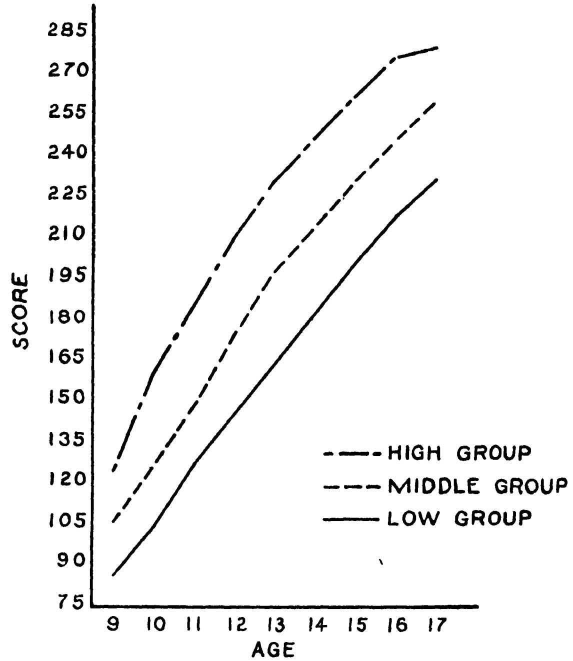

FIG. 3. Mean Scores of Three Groups of Pupils with Consecutive Tests from Eleven to Sixteen. (From Freeman and Flory, p. 65.)

Figure 3 indicates that the growth patterns for the low, middle, and high groups are similar, on the average, although it must be remembered that the low group would be about average in an unselected population. The slight differences in the form of the curves should not be regarded as significant, and the apparent break for the brightest pupils at age sixteen is probably an artifact. At this time bright pupils are likely to be promoted out of the school. There is nothing in the curves to indicate, up to the age of seventeen, a cessation of growth in these mental functions.

Obviously, results based on a sampling of this type should not be generalized to include curves of growth for dull children. Moreover, the tendency of growth curves based on different levels of ability to run parallel, converge, or diverge, will be in part a function of the difficulty and abstractness of the materials involved. We can assume that these VACO tests, and others of the same type, do not call upon the higher abstracting abilities of a selected population: were they less abstract than they are, the test materials would probably result in a convergence; if more abstract, the groups might well have fanned out.

Certain observations of Freeman and Flory should be repeated:

> When evidence is presented that intellectual ability increases beyond early or middle adolescence the objection is sometimes made that the later increase is not true intellectual growth but the product of education. This is predicated on the fact that those whose education ceases in the early adolescent years do not continue to advance as do those whose education continues.
>
> This objection implies a distinction between development due to organic growth or maturation and development due to education. It further implies that maturation is responsible for development up to a certain age and education beyond this age. And yet the two types of diverse development are measured by the same tests. These implications will not endure critical examination.
>
> The fact is that there is no ground for making a sharp distinction between that part of intellectual development which is due to maturation and that part which is due to education on the basis of the evidence of our present tests, or perhaps of any tests we can devise. Certainly we are not justified in setting a certain age as the terminus of maturation. Nor are we justified in concluding that maturation is the sole factor before a certain age and education thereafter. Education is a factor from the beginning. Maturation is doubtless a decreasing factor, but we are not at present able to set its age limit. (p. 93.)

Garrett and others,[1] starting from the hypothesis that simpler functions mature earlier than complex ones, and further that as children grow, special abilities emerge and tend to overshadow general ratings of ability, secured a representative sampling of 250 boys and girls for the age groups nine, twelve, and fifteen.

[1] Garrett, Henry E., Bryan, Alice I., and Perl, Ruth E.: The Age Factor in Mental Organization. *Archives of Psychology*, New York, 1935, 26, No. 176, pp. 31.

While the families of these school children from an eastern city represented about twenty national or racial groups, the children themselves were practically all American born. They were characteristic of a cross section of an industrial and residential city. The ten tests that were employed in the final analyses are briefly described below:

(1) Making "gates." This is a simple paper-and-pencil motor speed test.
(2) Vocabulary. Sixty items from Thorndike's CAVD vocabulary test.
(3) Forty problems from Thorndike's CAVD arithmetic test.
(4) Form board test. The Likert-Quasha Revision of the Minnesota Paper Form Board Test designed to measure spatial ability (time limit extended).
(5) Logical prose. A measure of immediate recall of a prose selection.
(6) Word-word. Memory for paired word associations.
(7) Word retention. Immediate recall of single words.
(8) Digit span. Ability to reproduce number combinations.
(9) Geometric forms. Ability to recognize geometrical forms that had been exhibited.
(10) Objects. Memory for small objects exhibited by attaching them to a large cardboard.

Garrett presents in Figure 4 a graph of the results for boys and girls in memory (Tests 5 to 10), vocabulary, and arithmetic. While this curve is not a true growth curve, it is possibly consistent with what would be found on longitudinal testing, for the sampling was chosen with unusual care and there would be little selection through dropping out of school by the age of fifteen. Even for tests that are simple, there is little indication that the curves are flattening out, with the exception of the performance in memory. The authors are unable to find any essential differences between "memory" tests and "nonmemory" tests. It is one thing to label a test and quite another to establish that it really lives up to its designation. An analysis of the intercorrelations indicates that the abilities measured by these tests tend to become more specific as the children advance in age. A factor analysis produced only one factor of any consequence in relation to the total variance of the test battery; it seemed to be consistent with a concept of differential maturation in the earlier child ages. The authors conclude that, so far as the ability represented in these tests is concerned, "the role of general ability is minimized in favor of special abilities as age increases."

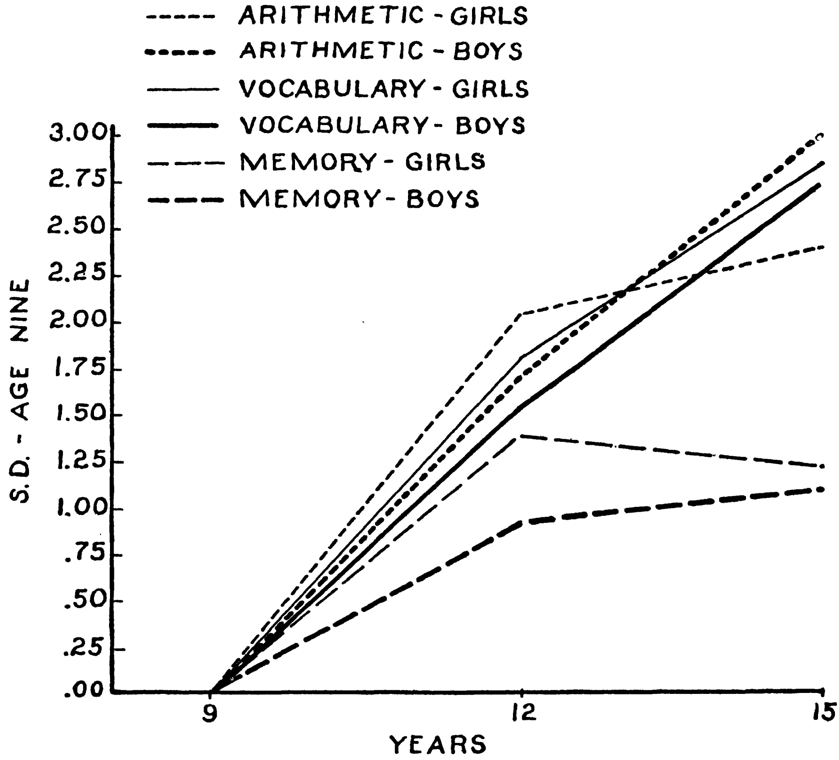

Fig. 4. Comparison of Boys and Girls on the Memory, Vocabulary, and Arithmetic Tests at Three Age Levels, Nine, Twelve, and Fifteen Years. Differences between Means Are Expressed in Terms of the S. D. of the Nine-Year-Old Group. (From Garrett, Bryan, and Perl, p. 15.)

The kind of mental testing available for adults almost completely prevents the filling out of the later portions of any curve of growth. When adults take Binet or Army Alpha tests they are impressed with the bookishness, if not the silliness, of the questions asked. They feel that fragmentary items discount their slowly achieved ability to see relations or to arrive at special and original solutions. For an adult who is regarded as highly intelligent (without benefit of testing, but in respect to the quality of his intellectual achievements), there is available a set of linguistic games and conundrums. It is not that he is likely to fail in such exercises, for, as a rule, he does well. But test-wise persons will equal his rating. Of all the persons who do well on a test, only a few are really good. Some adults of great capacity and insight may express their superiority through channels that are less than general, and therefore not available in tests of general scholastic aptitude. They may be, for example, outstanding in mathematics, music, or the graphic arts and sciences. Similarly this lack of test variability and richness along lines that are genuinely intellectual prevents a proper analysis of growth in the childhood years.

Such matters as the form, rate, and amount of mental growth, together with relations to other aspects of development, are obscured by the opportunistic selection of mental-test items. The bending of mental-test items and procedures toward practical services in school and clinic has concealed effectively the nature of the thought process underlying comparative performance. Some of these deficiencies can be removed with better testing, but no standardized scale, in itself, can furnish the analytic data that are needed.

Paradoxically the patient skill demonstrated by American mental testers in their work over the last generation has acted as a barrier to the further understanding of thinking in child and adult. *The millions of man-hours devoted to preparing, administering, scoring, interpreting, and defending mental measurements have yielded only a tiny dust heap of knowledge about language, thought, growth, and meaning.* For the most part, suggestions for stopping this gigantic merry-go-round of activity have come from workers outside the narrow field of measurement — from persons in child and abnormal psychology, in semantics, education, and psychiatry. Thus far their work is in the realm of theory, or of heavily documented observations of actual child behavior; to a slight degree it has moved toward the experimental.

THE INFLUENCE OF PIAGET

Piaget's work[1] is illustrative. On the basis of numerous observations of children of preschool and early school age, he tried to follow the course of mental maturation, developing a tendency to differentiate rather sharply in terms of a child's ability to approach adult reasoning. He regards the young child as seeing objects

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[1] Piaget, Jean: *Judgment and Reasoning in the Child.* New York: Harcourt, Brace and Company, 1928. Pp. viii, 260.

> . . . not as they really are, but as he would have imagined them, if, before seeing them, he had, *per impossibile* described them to himself . . . the child often sees only what he already knows . . . there exist before the age of 7–8 two planes of reality — play and the reality of ordinary life, but they are juxtaposed instead of being compared and ordered in a hierarchy, and each taken by itself is different from what it is for us. But at about the age of 7–8, certain changes take place in the modality of childish judgment which are in close relation to the appearance of a desire for a system and non-contradiction. This stage is characterized on the one hand by the beginnings of a positive observation of the external world, and on the other by an awareness of the implications contained in such reasoning as is connected with actual observation. (pp. 249–250.)

Piaget believes that at eleven or twelve, children are for the first time capable of logical experiment, that is, of pure hypothesis, conforming now to the demand of external points of view. Younger children are content with explanations that are neither consistent nor logical and they view the whole world as willed by persons or powers beyond themselves.

Piaget's study of the ways in which children develop their conceptions of the world[1] has yielded rich case material. It is in this simple approach, which could be subjected to experimental and statistical analysis without undue loss, and extended to cover persons, places, and events of every order, that psychology may advance beyond the essential meagerness of the mental-test item. An illustration, which Piaget regards as a "good example of artificialist belief stimulated by religious teaching, but in which the information imparted to the child has been seriously disfigured by his own contribution to it," will serve to show the method:

> Gava (8½): The sun is alive because "*it keeps coming back.* — Does it know when the weather is fine? — *Yes, because it can see it.* — Has it eyes? — *Of course! When it gets up it looks to see if it is bad weather and if it is it goes off somewhere else where it's fine.* — Does it know that it's called the sun? *Yes, it knows that we like it. It is very nice of it to make us warm.* — Does it know its name? *I don't know. But sometimes it must hear us talking and then it will hear names and*

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[1] Piaget, Jean: *The Child's Conception of the World.* New York: Harcourt, Brace and Company, 1929. Pp. ix, 397.

> *then it will know.*" All this seems to be pure romancing, but as we shall see Gava almost identifies the sun with God: "When your daddy was little was there a sun then? — *Yes, because the sun was born before people so that people would be able to live.* — How did it start? — *It was made in Heaven. It was a person who died and then went to Heaven. In Sunday School he is called God.* — Where did this person come from? — *From inside the earth.* — Where from? — *I don't know how he was made.* — How did that make the sun? — *The person was very red and that made the light. Even in the morning before the sun is out, it is light all the same.*" In other words this person (Jesus Christ) has set fire to Heaven and this light made the sun. Gava is thinking probably of Christ's halo. He went on to tell us of a picture in which God was like the sun but with arms and legs! "What is the sun made of? — *It's a big red ball.* — Made of what? *Of cloud . . . I don't know.* — Did it start a long while ago? — *Since there have been people.* — Not before? — *No, because there wouldn't have been anything to light.* — Did it start at the same time as people or after? — *It started as soon as there were little children.* — Why? — *So that children should have the fresh air.* — If you were to speak to the sun would it hear? — *Yes, when you say your prayers.* — Do you say your prayers to it? — *Yes.* — Who told you to do that? — *At Sunday School I was told always to say my prayers to it.*" (pp. 270–271.)

Throughout his work, Piaget insists upon a discreteness in the steps of logical progress up the chronological scale that probably would not be borne out in rigorous experimentation. A child's thinking is not always a pure form of all-or-none, nor are its stages marked by sudden upward surges that bear little relation to what the child is experiencing. Many children think like adults and many grownups think like children. The nature of materials, familiarity, stimulation, necessity, and success are factors that can push or pull; informed guidance and example from the preschool years upward may do much to bring the child earlier along the paths of logical process. We may begin to form a dim outline of the vast divergence in the rate of growth in intelligence and adjustment that is possible in relation to wedgelike influences upon children; for many a child, social amenities demand a silent, noncommunicative, private, mental life.

For a sampling of eighty-eight children, ranging in age from three to seven years, Hazlitt[1] found that some of the youngest children could achieve an understanding of the difficult term *except* and could find common elements in objects and designs presented visually. She summarizes her conclusions as follows:

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[1] Hazlitt, Victoria: Children's Thinking. *British Journal of Psychology*, 1929–1930, 20, 354–361.

> A further argument against the view that there is any radical difference between the thought processes of the child and of the adult, comes from the fact that when the adult has to think about wholly unfamiliar material he makes the same mistakes as the child. He even does it with familiar material if he has not been obliged to concern himself with it previously. For instance, Piaget tells how children in accounting for the displacement of water by objects of differing size and density sometimes give the weight as the cause, and sometimes the size, without bringing the two into relation or seeing any difficulty in giving different causes for the same phenomenon. I repeated his experiment with some non-scientific adults and found exactly the same results. They were no more disturbed by the contradictions in their answers than were the children. Piaget's picture of a striking difference between adult and childish thinking is, I believe, due to an over-valuation of verbal expression as a measure of thinking, and an exaggerated view of the logicality of adult thought. (pp. 360–361.)

If we compare a nonthinking child with a thinking adult, the differences found appear so consistent with our concepts of growth that we regard them as contributing to a necessary law. The corrective is applied when thinking children are compared with thinking adults, and particularly when thinking children are compared with nonthinking adults. What we need is a charting of the course of thinking in which one abstract level is truly regarded as higher than another. Reached by different children and adults according to their analyzed capacities, and in relation to various concatenations of environmental factors, the steps in this hierarchy would furnish the raw materials for test items and curves of growth.

To say that Piaget's ideas are stimulating is not to claim that they have as yet been subjected to sufficient experimental control for inclusion in a generally acceptable pattern. There is evidence from follow-up studies that some of Piaget's conclusions are not tenable, or at least not applicable to populations other than those originally observed. Some American children develop socialized speech in the preschool ages and their so-called egocentric speech is not without social implication. The peculiar speech that twins sometimes develop may be regarded as falling between egocentric language and standard social discourse. Abel[1] found that a group of American college women reacted to fairly difficult reading materials in a manner similar to Piaget's child subjects. Under experimental conditions they did not understand each other well, and the information they gave out was frequently egocentric or distorted.

A minor study by Grigsby[2] illustrates the fruitfulness of analyzing children's mental growth by these methods. To classify children's conceptions of physical causality, she employed Piaget's categories as follows:

Psychological motivation or precausality.
Finalism, in which no motive is involved.
Phenomenistic causality or contiguity in space and time.
Participation of two like but unrelated factors.
Magic in which there is no possible relation yet effect is produced.
Moral causality implying compulsion.
Artificialism or the production by personalities and things.
Animism.
Dynamism, implying internal force.
Action of the surrounding medium.
Mechanical causality through contact and transfer.
Generation, two factors born of each other.
Substantial identification implying the making from substance — not being born.
Existence through condensation and rarefaction.
Atomistic composition.
Spatial cause.
Logical deduction or inference.

To these, she added five divisions: cause and effect, origin, composition, inconsistencies and contradictions, and irrelevant responses. She was able to classify all the responses of the eighty-three preschool children in the Iowa Child Welfare Research Station who were the subjects.

In addition to compiling information concerning the child's concepts of time, number, space, and various logical relationships, Grigsby found four stages of development in *causal relation*. In the first of these, desire, existence, and contiguity in space or time were regarded as causal. In the second stage, an external power, such as *God* or *man*, was postulated, the objects themselves being endowed with consciousness. The third stage is on the road to adult acceptability, in that proper causal sequences, while observed, are still somewhat obscure. In the final stage, there is found an appropriate statement of cause and effect, together with standard logical inferences. It is amazing that these bright preschool children, by the age of five, should have converged upon the postulation of deity as a supreme cause of natural phenomena. Table 1 shows the rise in this designation from Group I (two-year-olds) to Group IV (five-year-olds) in response to the questions, *where does the snow come from,* and *what is rain?* (Since Grigsby's sampling is small and socially selected, her results are merely suggestive.)

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[1] Abel, Theodora Mead: Unsynthetic Modes of Thinking Among Adults: A Discussion of Piaget's Concepts. *American Journal of Psychology*, 1932, 44, 123–132.

[2] Grigsby, Olive John: An Experimental Study of the Development of Concepts of Relationship in Pre-school Children as Evidenced by Their Expressive Ability. *Journal of Experimental Education*, 1932–1933, 1, 144–162.

TABLE 1[1]

PERSONALITIES HELD RESPONSIBLE BY PRESCHOOL CHILDREN FOR THE PHENOMENA OF SNOW AND RAIN

Group I	*Group II*	*Group III*	*Group IV*
teacher	Santa Claus	God (7)	Jesus (12)
someone	Jack Frost	Jesus (4)	God (20)
man	person	Santa Claus	
Jesus	God (2)	they	
God	people	he	
mother	he		
I	man		
they	they		

Of this tabulation, Grigsby remarks:

> . . . In employing God and Jesus among other personalities (Santa Claus and Jack Frost) as explanations of cause, the younger children called upon those endowed with extraordinary powers to explain phenomena which seemed not to be caused by ordinary human activity. This is merely an outgrowth of the children's stage of development. But with increased emphasis upon divine power, the force of education shows itself. There is no doubt but that relations involved in the phenomena of snow and rain are more difficult than those in the more immediate concrete experiences of the child's everyday life, and it is not strange, therefore, that he uses a less mature type of response. But when two-thirds of the responses are similar, one is led to the conclusion that a far-reaching

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[1] From Grigsby, p. 151.

> principle has found its way into the education of the child. One of two things has happened. Either he has been taught that God and Jesus do all things, with the result that this has a very general carry-over in his new experiences, or in his environment all things not understood are explained by positing a deity as cause. Such an explanation requires no thinking and is satisfactory for the child until additional experiences force him to modify his concepts. Then this mystic power explanation hinders the development of mature modes of thought. (p. 151.)

Already the child has learned to substitute magic for mental activity. It is not so important that he has ascribed to the deity certain incommensurables, but that he is satisfied with an end point. Henceforth parents, teachers, and religious leaders will conspire to nail down his immature judgments; they will remove the question marks from unanswered problems. This is a form of mental inertia that hastens decline and deterioration; it is the twist of the hand that makes the hoop twirl backward while it is going forward.

Welch,[1] while he does not go as far as Piaget [2] in postulating discrete, ladderlike increments in logical facilitation, recognizes a hierarchy of concepts:

> The mature human mind can entertain ideas and can communicate ideas which are called classes -- classes that in turn include other classes . . . our knowledge of mental deficiency in general must depend to a large extent on what we discover concerning the limitations of the defective in grasping concepts above very low levels of classificatory thinking. (p. 359.)

Welch believes that in the development of abstract thinking the factors are discrimination (the ability to tell a difference), generalization, and meaning. He admits the factor of motivation, but believes it to be different in type. He distinguishes stages which should be compared with Piaget's studies of concept formation: (1) preabstract, from zero to two years; (2) the genus-species relationship, and (3) other types of genus-species relationships involving the same objects. These postulates, like Piaget's, need experimental checking. Children living under different cultures may so radically alter the amount of time spent at any logical stage, and perhaps the sequence of events, that there is no room for fixed classifications with sharp edges. Moreover, the order of events culminating in a maturity of insight will vary with the medium employed; as we have seen, American adults are more advanced in verbal forms than in graphic representation.

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[1] Welch, Livingston: A Preliminary Investigation of Some Aspects of the Hierarchical Development of Concepts. *Journal of General Psychology*, 1940, 22, 359–378.

[2] Piaget, Jean: The Child's Conception of Physical Causality. New York: Harcourt, Brace and Company, 1930. Pp. viii, 309.

For the normal child, under common conditions of stimulation and experience, there is a fabric of correlated abilities that furnishes materials for mental testing. It may be short or long: if short, it is spun out of simpler materials suitable to the early ages of childhood; if long, the designs, while still fragmentary, become more difficult and complex. But for adults who have deteriorated, perhaps to an abnormal degree, we have a fabric that is spotted, frayed, and full of holes. In such cases, there must be a dependence upon special tests of ability and achievement, together with expert clinical observations. Maturity in certain areas can be accompanied by immaturity in others. Since, over a long span of years, the normal adult who grows at a decelerated pace and then deteriorates is usually not a "one-hoss shay," curves of maturation so general as to be expressed in a single quotient will reveal little.

Abnormal Variations

Certain of Piaget's methods have been adapted by Cameron[1] for the purpose of studying adults. With respect to the ability to describe events in terms of cause and effect, the adult schizophrenics were far superior to the six-year-old children, the latter devoting a high percentage of their responses to what Piaget called *psychological motivation* (e.g. "A boy threw a stone at me because he wanted to hit me."). When the schizophrenics were classified into three stages of mental disorganization—the "mild," the "moderate," and the "severe"—there was no consistent tendency observable. On the basis of these observations, Cameron concludes:

> Schizophrenic thinking tends to stick to everything it touches. Its loose structure permits the presence at the same time of potentially contradictory elements. This is possible simply because the

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[1] Cameron, Norman: *Reasoning, Regression and Communication in Schizophrenics.* Psychological Monographs, 1938, 50, No. 1, pp. 34.

> actual contradiction which would arise in the process of the functional organization of concept-formation does not come to pass. A false equilibrium results which then no longer requires the elimination of one term simply because it is not brought explicitly into relation with its opponent. The result is incongruity and ambivalence. That asyndetic thinking is part of the schizophrenic process is evident from its appearance in one of our cases at the height of the illness and its spontaneous disappearance with partial recovery. This points the way to another measure of disorganization and recovery; and it deserves further emphasis because in the asyndetic form of reasoning one may recognize evidences of that mild language disorganization which often heralds an early schizophrenic development. (pp. 29-30.)

The bridge from this type of problem solving to what happens to the normal child or adult is indicated in another study by Cameron,[1] based on intensive work with five patients:

> It often happens that a normal person cannot effectively determine the limits within which he must act, and what does and does not belong within those limits. Under such circumstances he likewise fails to organize the situation in such a way that his operations are confined within effective limits. In consequence, the organization which to another person appears as "the problem" may not exist for him at all. When, for example, a normal person is unable to keep purely personal matters out of a situation, when they are neither helpful nor strictly relevant to it, his behaviour may come to resemble in a milder form what we have seen in these schizophrenic patients. That is, a life-situation under these conditions does not become sufficiently restricted, and the fringe-elements are not eliminated. Emotional reactions of a purely personal character, and not actually essential to the situation under consideration, when nevertheless included in it, may destroy the relative neutrality which is necessary if one is to maintain an objective attitude. The outcome is that, instead of growing progressively more and more definitive and delimited, such a life-situation may become so entangled with extraneous material and with personality problems as to defy solution.
>
> In our experimental situation one has the opportunity of examining something similar in an exaggerated form. For the disorganized schizophrenic patient "the problem," as the normal person experiences it, often does not exist. The boundaries remain too fluid, particularly with relation to personal material, but also with respect to the impersonal. (p. 1031.)

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[1] Cameron, Norman: Schizophrenic Thinking in a Problem-Solving Situation. *Journal of Mental Science*, 1939, 85, 1012–1035.

American workers are not so enamored of classes, stages, and categories as Piaget, but following his ingenious leads as to how children think and learn, they could, by the further use of experimental and statistical controls, arrive at an understanding of fundamental progress in the modes and conditions of thought. It does not appear feasible to undertake a radical reform in mental testing until validated materials of this type are at hand.

CHAPTER VIII

ORGANIC CORRELATES OF MENTAL GROWTH

We need to know the particular blockings and facilitations in mental growth; we need to know why intact adult nervous systems, which any physician would rate *healthy*, may develop and furiously defend logical patterns as immature as those found in the lower rungs of Piaget's ladder. In growth patterns, time is measured by the changes that take place — changes in size, structure, and relative function. The healthy nervous system is like a smooth-running car that may be sent to perform an errand of mercy, or to take a gangster "for a ride." While any destruction of healthy nervous tissue will affect the adequacy and reliability of the thinking process, there may be disjunctions at a high order of abstraction that spring from a poor choice of social inheritance and experience. According to cultural and social criteria, the brain of the learned man is better than that of his ignorant twin, but it may show up no better in terms of organic health. We postulate for the educated brain a physical *difference* and a cultural *superiority.*

PHYSICAL FACTORS

Todd[1] has indicated that, with respect to size and form, the child's brain is practically completed by the age of six. After that age, concepts of maturation are especially difficult to apply. Still the six-year-old brain cannot perform abstract tasks as successfully as the sixteen-year-old brain. Does the later advantage lie in the accumulation of information, relationships, and problem-solving habits? If the brain is truly done at this early age, then all the hereditary differentials should be regarded as available for study, and all mental measurement designed to separate the innate from the acquired would pivot around the preschool ages. But at six, the child's nervous mechanism, being in control of an immature, fast-growing physical and chemical pattern, is in itself immature; it cannot be otherwise. The organism is not growing by gross increments, but in terms of complex interrelationships. The brain that succeeds in taking on new learning, especially learning at a higher level of difficulty or abstraction, is "growing," even though the method of growth eludes the observations of the anatomist and neurologist.

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[1] Todd, T. Wingate: The Growing-up Pattern. *Progressive Education,* 1934, II, 445-450.

I suggested earlier that the principal sources of relationship between intelligence and physical factors would be found through coordinated studies of the development of the nervous system and of the abilities involved in the new concept of intelligence. Analogously, enduring relationships between nonphysical factors and intelligence may be found primarily in those areas in which the aptitudes sampled by an intelligence test are a part of the behavioral and cultural experience. The attempt to pass over from gross anatomy or gross cultural nourishment to demonstrably related changes in intelligence has proved complicated. The significant correlations that have been obtained exist because general anatomical conditions and certain scholastic and cultural situations are likely to involve, in a diluted fashion, the intimately related variables.

Idiots and other heavily deteriorated specimens are likely to exhibit shortness of stature and a degree of motor impairment. These relationships in a small percentage of the population will contribute to correlations disproportionately, in view of the large product moments indicated in a scatter diagram. At the other end of the distribution, a similar phenomenon is observable, although to a less marked degree. On the whole, tallness in this country is associated with the selection of a population in terms of north-European ancestry whose economic and social place has long been somewhat privileged. The immigrant that is most alien is the one who differs most from our Anglo-American culture along the lines of size, skin color, physiognomy, language, and tradition. These clusters are associated in the popular mind with certain nationalities and with the selection of occupations in this country. Out of this welter of anatomical, racial, national, economic, and cultural factors, it has always been difficult to arrive at good sampling, good testing, and an adequate experimental control. It could be held that, if we can establish a significant correlation between height and intelligence, it matters little whether height is a function of Scotch or Sicilian forebears. Perhaps it does not matter, so long as we recognize the restrictions to this observation. It is one thing to say that, in a mixed population, tallness is associated with brightness and another to imply that this relationship holds for a homogeneous national or racial group. For such inferences, not one, but two major inquiries are indicated. Similarly, if in studying the relationship between physical and mental measurements across both sexes, we fail to distribute each sex separately, the male will be found heavily represented in the upper portion of the distributions of height, weight, and size. Samplings of this type would yield correlations different from those in which the sexes were separated; they would probably reduce to zero any slight tendency for tallness in either sex to be associated with brightness: the tails of the composite curve (consisting almost exclusively of the tall men and the short women) might not counteract the moment-weight of tall bright women and short dull men found near the center of the distribution.

Paterson's Review

A summary of the relationship between physical and mental growth contained in studies prior to 1930 has been reported by Paterson.[1] He decided that for large populations, principally at the school age, the two curves of growth, physical and mental, could be considered as essentially independent of one another. This does not refer to the possibly closer correlation between anatomic growth and behavior in the prenatal, infancy, and early preschool years, nor is it consistent with the well-established observations of a concomitance of physical and mental impairment in certain glandular and motor disorders. Similarly, anatomical malformations and the ravages of diseases and injuries may set limits to intelligence that would appear as significant relationships between physique and intellect. Since, at the other end of the age scale, senescence is marked both by physical and mental deterioration, a refinement of data would show positive relationships. These would not be high, for the presence of "a good mind" in a deteriorated body, and of extreme mental impairment in an otherwise healthy human animal, bears testimony to a limited degree of autonomy for the nervous system.

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[1] Paterson, Donald G.: *Physique and Intellect.* New York: D. Appleton-Century Company, Inc., 1930. Pp. xxvii, 304.

Anthropometric Measurements

Without losing sight of the restrictions and difficulties outlined by Paterson, particularly as applied to the older methods of investigation, we may turn now to some of the more recent studies of mental and physical development.

A study was completed a few years ago by Abernethy,[1] utilizing elementary-school, high-school, and college subjects who represented a high economic and scholastic level, the mean Stanford-Binet IQ being 116. The physical measurements and mental tests were administered by experienced persons. Abernethy reports that for the laboratory schools (elementary and high schools), involving 357 cases in her tabulation, the pupils "are unusually homogeneous with respect to economic and cultural status. As members of a highly selective private school, they are, with few exceptions, well-nourished, carefully trained, healthy, energetic children. There is less homogeneity in race; approximately 20 per cent of each sex are Jewish. The non-Jewish children are, in the main, from a mixture of Northern European races." (The term *race* is loosely employed.)

For the children in the laboratory school, the correlations between mental test score and various physical measurements are reproduced in Table 2.

The intelligence test employed for all these correlations was the point-scale constructed by F. N. Freeman on the basis of verbal analogies, word opposites, sentence completion, and vocabulary. Unlimited time was allowed. The relationships appear to be negligible, except for the height measurements at the later ages, and these are uniformly low. For a sampling of forty-five girls measured on their fourteenth, fifteenth, and sixteenth birthdays, there was a tendency for the low correlations with mental age at age fourteen to drop to zero by the age of sixteen, for standing height, sitting height, weight, and chest girth. Abernethy regards

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[1] Abernethy, Ethel Mary: *Relationships between Mental and Physical Growth.* Monographs, The Society for Research in Child Development, 1936, 1, No. 7, pp. vii, 80.

TABLE 2[1]

CORRELATION OF SCORES ON PSYCHOLOGICAL TEST WITH MEASUREMENTS OF PHYSICAL TRAITS

Age	Boys	Girls	*Physical Variables Correlated with Psychological Scores*							
			Standing height				*Sitting height*			
			Boys		*Girls*		*Boys*		*Girls*	
			r	*P.E. of r*	*r*	*P.E. of r*	*r*	*P.E. of r*	*r*	*P.E. of r*
8	33	32	.16	± .11	.20	± .11	− .19	± .11	.05	± .12
9	58	65	.07	± .09	.07	± .08	− .02	± .09	− .03	± .08
10	91	92	.26	± .07	.21	± .07	.15	± .07	.09	± .07
11	112	114	.34	± .06	.13	± .06	.25	± .06	.07	± .06
12	116	112	.33	± .06	.15	± .06	.26	± .06	.16	± .06
13	115	95	.29	± .06	.12	± .07	.27	± .06	.16	± .07
14	112	89	.33	± .06	.21	± .07	.27	± .06	.20	± .07
15	94	77	.32	± .06	.18	± .07	.31	± .06	.23	± .07
16	62	51	.31	± .08	.17	± .09	.26	± .08	.09	± .09
17	32		.23	± .11			.25	± .11		
			Weight				*Ossification ratio*			
8			.10	± .12	− .04	± .12	.15	± .11	.02	± .12
9			.17	± .09	− .08	± .08	.05	± .09	.10	± .08
10			.25	± .07	.19	± .07	.02	± .07	− .06	± .07
11			.19	± .06	.18	± .06	.14	± .06	.05	± .06
12			.14	± .06	.16	± .06	.25	± .06	.07	± .06
13			.13	± .06	.20	± .07	.17	± .06	.17	± .07
14			.20	± .06	.18	± .07	.11	± .06	.06	± .07
15			.27	± .06	.16	± .07	.10	± .07	.13	± .08
16			.21	± .08	.05	± .10	.13	± .08	− .12	± .09
17			.12	± .12			.11	± .12		
			Chest girth				*Lung capacity*			
8			.04	± .12	− .17	± .12	.27	± .11		
9			.23	± .08	− .18	± .08	.12	± .09		
10			.14	± .07	.18	± .07	.23	± .07		
11			.15	± .06	.16	± .06	.19	± .06		
12			.11	± .06	.19	± .06	.24	± .06		
13			.05	± .06	.21	± .07	.14	± .06		
14			.07	± .06	.19	± .07	.16	± .06		
15			.16	± .07	.08	± .08	.12	± .07		
16			.01	± .09	− .02	± .10	− .04	± .09		
17			.14	± .12			.07	± .12		

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[1] From Abernethy, p. 12.

this as indicative of a slight relationship between mental test performance and the stage of physiological maturation; presumably at maturity and thereafter, this correlation would stay at the zero level.

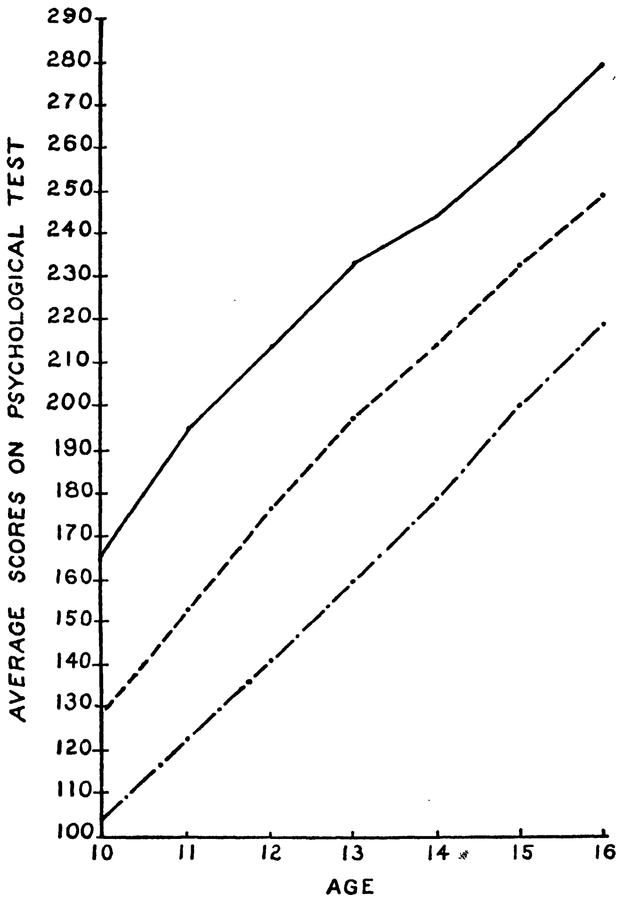

FIG. 5. Mental-Growth Curves of Groups of Boys Different in Level of Psychological-Test Scores. (From Abernethy, p. 37.)

The growth curves of boys and girls at different levels of performance on Freeman's mental test are given in Figures 5 and 6. The data utilized in these curves are based on only fourteen cases for each category, as indicated in Table 3.

For different ages of pubescence, growth in the scores for girls on the Freeman test is given in Figure 7.

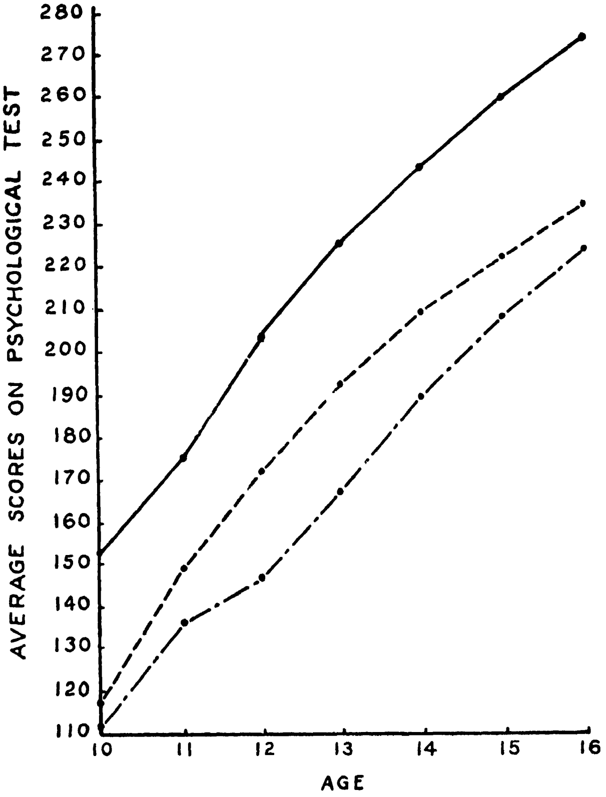

FIG. 6. Mental-Growth Curves of Groups of Girls Different in Level of Psychological-Test Scores. (From Abernethy, p. 38.)

TABLE 3[1]

AVERAGE PSYCHOLOGICAL SCORES FROM AGE TEN THROUGH SIXTEEN FOR GROUPS OF BOYS AND GIRLS DIFFERENT IN LEVEL OF TEST SCORES

Group	*Number of Cases*	*Mean of Psychological Scores at Age*						
		10	*11*	*12*	*13*	*14*	*15*	*16*
Boys: High . . .	14	165	194	214	234	246	263	282
Middle . .	14	129	153	176	198	215	234	250
Low . . .	14	105	123	141	160	180	201	221
Girls: High . . .	14	152	176	204	224	243	259	274
Middle . .	14	118	149	172	192	208	222	234
Low . . .	14	112	138	147	168	190	208	223

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[1] From Abernethy, p. 35.

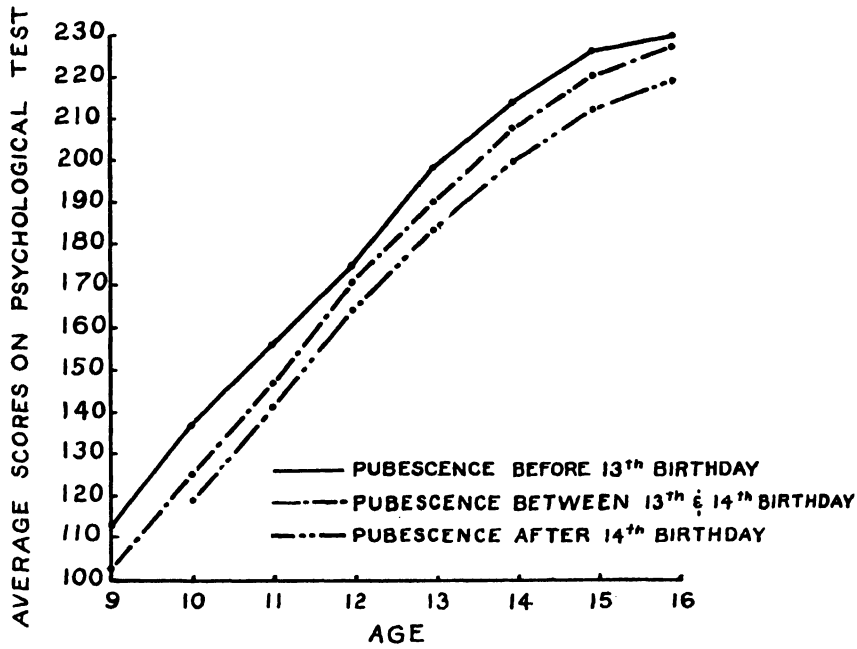

FIG. 7. Average Scores on the Psychological Test for Girls of Different Maturity Groups. (From Abernethy, p. 48.)

Data for this curve are presented in Table 4.

TABLE 4[1]

AVERAGE SCORES ON PSYCHOLOGICAL TEST FROM AGE NINE THROUGH SIXTEEN FOR GIRLS OF THREE MATURITY GROUPS

Age	*Period of Pubescence*								
	Before 13th birthday			*Between 13th and 14th birthdays*			*After 14th birthday*		
	N	*Mean*	*S.D.*	*N*	*Mean*	*S.D.*	*N*	*Mean*	*S.D.*
9	23	113 ± 4	26	10	102 ± 5	23			
10	35	137 ± 3	27	18	126 ± 4	23	8	120 ± 3	14
11	52	157 ± 3	30	21	149 ± 4	28	12	142 ± 5	24
12	56	175 ± 3	30	24	172 ± 4	27	14	166 ± 4	21
13	49	198 ± 3	34	25	191 ± 3	25	18	185 ± 4	23
14	44	214 ± 3	34	25	209 ± 3	23	21	201 ± 3	20
15	36	226 ± 3	30	22	220 ± 3	21	20	212 ± 3	23
16	25	229 ± 4	32	14	228 ± 2	13	15	220 ± 2	14

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[1] From Abernethy, p. 47.

For a comparison between the mental and physical traits of adults there were available 140 women between nineteen and twenty-four years of age and 140 men between twenty and twenty-five, all selected scholastically to the extent that they had graduated from an accredited high school. The data are given in Table 5.

TABLE 5[1]

COEFFICIENTS OF CORRELATION BETWEEN SCORES ON PSYCHOLOGICAL TEST AND MEASURES OF STANDING HEIGHT AND WEIGHT; DATA FOR UNIVERSITY MEN AND COLLEGE WOMEN

Group	*Height and Mental Test*		*Weight and Mental Test*	
	N	*r*	*N*	*r*
University men (all cases)	140	− .01 ± .06	140	− .09 ± .06
College women (all cases)	140	.00 ± .06	140	− .09 ± .06
All men within 2 S.D. of mean . .	131	− .05 ± .06	134	− .11 ± .06
All women within 2 S.D. of mean .	136	− .04 ± .06	134	− .04 ± .06
University of Chicago men . . .	100	.01 ± .07	100	− .08 ± .07
State University men	40	− .08 ± .11	40	− .18 ± .10

From Abernethy's work, we may conclude that any relationships to be found between gross physique and scholastic aptitude will be discovered in the early periods of childhood or under conditions of abnormal variation. It might be, for example, that the failure of a preschool child to achieve increments of growth over a given time, consistently with expectations from hereditary and environmental factors, would be paralleled to some degree by a deceleration along mental lines. But this postulate and all like it await further investigation.

Brain Waves

Eventually we may hope for at least crude measures of correlation between nervous function and mental output at a given time. Thus, Knott[2] feels that there may be an increasing order of instability in brain potentials as the subject advances to more complex mental acts. He and Travis found preliminary evidence that cortical potentials are less stable during silence than during sleep, and are still less stable as the subject takes up silent reading or a combination of speech and reading.

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[1] From Abernethy, p. 64.

[2] Knott, John R.: Brain Potentials During Silent and Oral Reading. *Journal of General Psychology*, 1938, 18, 57–62.

Brain Weight

Thus far attempts to establish relationships between brain weight and intelligence have been fruitless, within the normal range of variation. Donaldson[1] believes that we would be on the wrong track in attempting to establish any such relationship, noting that the wild Norway rat has a heavier brain than the captive albino simply because its neurons, while the same in number, are larger. He holds that this may be true of man, and also that changes in the size of neurons would probably not disturb the weight relations within different parts of the brain. His final suggestion is to change the locus of search:

> If, however, we change our mode of attack and approach from the side of the nutrition of the brain, the situation is altered. It appears that the vascular tree, represented by the vessels in the pia, is better developed in the intellectuals. This apparently means a better blood supply to the cortex, and it is unquestioned that such would contribute to a better performance. (p. 212.)

Carmichael,[2] noting the failure to find a satisfactory anatomical basis for the mental superiority of man over the other animals, observes "that man's intellectual processes that are qualitatively in a class by themselves are dependent upon, it may be, a relatively slight improvement *quantitatively* in the ability to use symbols and language. Thus a slight improvement of a certain sort in the brain gives man his overwhelming advantage of being able to profit by the past experience of the race as contained in concepts and symbols." (p. 123.)

With respect to man's individual development, there is of course a great increase in brain weight from infancy up through early childhood. Regarding this phenomenon, Carmichael states:

> It would be going far beyond the facts to allege that the growth of intelligent behavior that is measured during the first, second, third,

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[1] Donaldson, Henry H.: The Brain Problem — In Relation to Weight and Form. *American Journal of Psychiatry*, 1932–1933, 12, 197–214.

[2] Carmichael, Leonard: The Physiological Correlates of Intelligence. The Thirty-ninth Yearbook of the National Society for the Study of Education. *Intelligence: Its Nature and Nurture*. Part I. *Comparative and Critical Exposition*. Bloomington, Ill.: Public School Publishing Company, 1940. Pp. xviii, 471. (pp. 93–155.)

> fourth, and subsequent years can be thought of as a mere correlate of the changes resulting from the inner *growth* of the nervous system during this period. That much behavior change during this period is dependent upon sheer growth rather than upon specific environmental change, however, is suggested by analogy with the functional changes that accompany the growth of the lower brain centers during fetal life. . . . There is thus good evidence that alterations in the character of intelligent behavior during early years are related to the gradual maturation (that is, growth in all its details) of the brain. In all this development, the exact part that may be played by "exercise" (external environmental stimulation) is still open to debate. It seems clear, however, that exercise at one time does not have the same effect that it will have at a later time. (pp. 125–126.)

Basic Metabolic Rate

Various studies have reported the correlations obtained between intelligence and the basic metabolic rate. On the basis of measurements for fifty-two university women (utilizing percentile scores from the Ohio State University college entrance examination), Patrick and Rowles[1] reported a zero relationship ($r = .01 \pm .10$). Hinton[2] has made a further study of basal metabolic rate. (He reported in 1936, on the basis of ninety children, a correlation of $r = .74 \pm .03$ between basic metabolic rate and Stanford-Binet IQ's.) It is based on one hundred boys and one hundred girls from six to fifteen years of age, with twenty cases at each year level. These children were from private schools and from an orphanage. The relationship reported is substantial, dropping slightly from $r = .80 \pm .06$ at year six to $r = .53 \pm .11$ at year fifteen. Similar correlations were obtained between BMR and the Grace Arthur Point Performance Scale. Hinton states that all the children in his study were in good physical health, and that the BMR's obtained were free from the disturbances of temporary factors. Considering the unreliability present in the measurement of both functions and the difficulty of visualizing, within the normal organic or behavioral range, a close connection between BMR and IQ, we should regard these figures with caution. (That a slight correlation could be established in an unselected population is not unreasonable in view of the connection between cretinism and thyroid deficiency, together with the tendency at home and at school to reduce the confidence of children who exhibit, at the earliest ages, any endocrine or other organic deficiencies.)

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[1] Patrick, James R., and Rowles, Emmett: Intercorrelations Among Metabolic Rate, Vital Capacity, Blood Pressure, Intelligence, Scholarship, Personality, and Other Measures on University Women. *Journal of Applied Psychology*, 1933, 17, 507–521.

[2] Hinton, Ralph T., Jr.: A Further Study on the Role of the Basal Metabolic Rate in the Intelligence of Children. *Journal of Educational Psychology*, 1939, 30, 309–314.

Recent work by Shock and Jones[1] has produced results unlike those of Hinton, but consistent with the findings of Patrick and Rowles. On the basis of forty-four adolescent boys and forty-three adolescent girls, with an average age of fourteen years, they obtained correlations with the Terman Group Test of Mental Ability that ran close to zero, the highest two being for the girls' oxygen consumption in calories per square meter per hour ($r = .27$) and the girls' oxygen consumption in cubic centimeters per kilogram per minute ($r = .26$). The correlations for the separate sexes between mental test and the base metabolism computed as a per cent deviation from Boothby and Sandiford norms were, respectively, $r = .07$ and $r = .05$. None of the correlations obtained was statistically significant. Shock and Jones conclude:

> Slight variations in functional activity of the thyroid gland are not reflected in changes in mental capacity because in most individuals other adaptive mechanisms are present which may compensate for this thyroid deficiency. However, as the thyroid deficiency becomes more and more acute a point is reached beyond which compensations cannot occur, with the result that mental retardation appears as a symptom; as the metabolic rate falls from a -15 or -20 to a -40 or -50, mental retardation becomes increasingly manifest, with the appearance of cretinous symptoms. In other words, it may be conjectured that we are dealing with a non-linear function, and are attempting to measure the relationship between two variables with an inadequate technique. Animal experimentation will probably be necessary in testing the above hypothesis. (p. 374.)

NUTRITIONAL FACTORS

While the relation between general intelligence and nutrition is a question of perennial interest, there is a dearth of relevant studies. The technical difficulties attached to such inquiries are great. For children organically normal at a given age, the effects of diet, except at the extremes of deprivation, are slow and obscure. There is only one line of direct relationship possible between diet and mental growth, and that is in terms of actual changes in the organism. Of course there may be correlations, in that the average IQ's of children in the higher socioeconomic levels fall above the mean of the whole population; at these levels families usually provide a better diet and health regimen. No doubt there could be found in American samplings a slight correlation between ratings of dentition and mentality. Another indirect relationship may arise through the effects of schooling and other forms of mental stimulation, for the child who is undernourished or unhealthy may have a poor attendance record in school and be subject to earlier and more pronounced fatigue. By having fewer opportunities to learn, he will reduce his learning aptitudes, the inferiority showing up in standard mental tests. However, we need to know the occupation of the child while ill or absent from school, since the invalid child might be exposed to more reading, conversation, and personal attention than the pupil who is only one of fifty in an understaffed classroom.

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[1] Shock, Nathan W., and Jones, Harold E.: The Relationship Between Basal Physiological Functions and Intelligence in Adolescents. *Journal of Educational Psychology,* 1940, 31, 369–375.

It is true that a few minor studies, utilizing animals as subjects, have indicated a possible relationship between certain intensive types of feeding (as with vitamin B complex) and the ability of the rat to solve problems. Here again, the kind of problems that the rat is asked to solve, as in mazes, may require more of a general bodily function than do the typical intellectual problems that confront children. If this hypothesis is sound, we should expect any relationship between nutrition and mental growth to be stronger in the infant and preschool years when the total sensory and motor mechanism plays a large role in the child's problem solving. At the extremes of malfeeding, the picture changes. We must then bring into consideration not only the general quality and quantity of food but the presence or absence of essential materials. The effects upon the child of specific deficiencies that block tissue growth, or permit the increase of toxic substances, are comparable to the action of drugs upon the organism.

Drugs

Results on the administration of benzedrine sulfate are thus far minor in character and inconsistent as to outcome. Molitch and Eccles,[1] utilizing ninety-three boys in a New Jersey state home, found an increasing tendency to gain in score on a group intelligence test with administrations up to 30 mg. of benzedrine sulfate. They found also a gain after taking only a placebo tablet. However, for essentially the same sampling, Molitch and Sullivan [2] reported a substantial difference favoring dosages of 10 mg. and 20 mg. of benzedrine sulfate, in relation to total score on the Stanford Achievement Test. Hecht and Sargent,[3] in a recent study, were unable to find, in a reasoning test, any reliable effects whatever from the giving of small dosages of benzedrine to college students. Regardless of the frequent reports of improved euphoria from the taking of this drug, it remains to be demonstrated that a general mental facilitation follows. Thus far the experiments have been of a preliminary nature, carried on without a knowledge of the effects of different dosages upon individual cases, and without benefit of a thorough follow-up program in mental testing.

From scattered accounts of the effects on temporary problem-solving and reasoning ability, it may be assumed that oxygen deprivation and the utilization of alcohol and tobacco in small dosages will exert an impairing effect. As the dosages increase there will be reached, for any individual, a point of obvious impairment and perhaps permanent effect upon mental ability.

In this whole area, some factors that need further study, with substantial samplings, are the following:

(1) The effects of differences in the amount and timing of dosages.

(2) A study of individual reactions and of the effects of acclimatization, for the two sexes, and at various age levels.

(3) In addition to a study of the immediate shifts in ability, intensive studies of the long-time effects of various drugs and dosages that have become habitual.

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[1] Molitch, Matthew, and Eccles, August K.: The Effect of Benzedrine Sulfate on the Intelligence Scores of Children. *American Journal of Psychiatry*, 1937, 94, 587–590.

[2] Molitch, Matthew, and Sullivan, John P.: The Effect of Benzedrine Sulfate on Children Taking the New Stanford Achievement Test. *American Journal of Orthopsychiatry*, 1937, 7, 519–522.

[3] Hecht, R., and Sargent, S. S.: Effects of Benzedrine Sulfate on Performance in Two Tests of Higher Mental Functions. *Journal of Experimental Psychology*, 1941, 28, 529–533.

(4) Further studies of physiological events, with special reference to various portions of the nervous system.

(5) The utilization in experiments of mental tests that are suitable for the adult ranges, and for the higher abstract processes at any age.

(6) More attention to the psychological controls; a placebo tablet, for example, may be stimulating in terms of the awakened interest of the subject in an experiment.

(7) The mental effects from standard medical administration, with special reference to sulfur compounds; of new occupational hazards, as in aviation; the effects of changes in blood chemistry arising from various emotional states.

(8) The role of such factors as fatigue, general nourishment, sleep, and exercise — in various combinations, and in reference to drugs.

Obviously there are many practical and theoretical discoveries awaiting the physiological psychologist who is willing to work intensively in this field. Until the work indicated is far along we can do no more than concur in Carmichael's observation:[1]

> Since also many environmental factors, such as nourishment, especially including the appropriate provision or exclusion of the vitamins, oxygen, toxic substances, disease products in the blood stream, and the like, are known to influence the development of the brain, whatever its hereditary "potentiality" may be, such factors should be controlled to the fullest degree possible by a society that wishes to maintain the maximal intelligence in the behavior of its population. Thus, every effort may well be made by society and by educators to provide the most adequate human nourishment in its completest sense in an environment as free as possible from toxic agents in order to influence the optimal growth of each brain and thus to allow the optimal education for each human brain within the boundary set by the inherited anatomical limits of each brain. (p. 144.)

We cannot predict the "millennium" when the physiologist and physiological psychologist, working primarily within the skin, join hands with the social psychologist, educator, and public worker. Yet, until this great chasm is bridged, in a manner comparable to what has been accomplished in medicine, there is little hope for an improvement in educational and social procedures sufficiently radical to bring each person to his highest level of development, achievement, and behavior.

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[1] Carmichael, Leonard: The Physiological Correlates of Intelligence. The Thirty-ninth Yearbook of the National Society for the Study of Education. *Intelligence: Its Nature and Nurture.* Part I. *Comparative and Critical Exposition.* Bloomington, Ill.: Public School Publishing Company, 1940. Pp. xviii, 471. (pp. 93–155.)

PREMATURITY

The search for concepts, test items, and predictive signs appropriate to mental measurement has been extended even to prenatal life. Richards,[1] for example, has assembled preliminary evidence in support of a relation between fetal movements and subsequent performance in the Gesell Schedules.

Apparently there is no relationship between prematurity, as determined by low birth weight (under 2,500 grams), and general intelligence as measured in the infant and preschool years by the Gesell Developmental Schedule, the Kuhlmann-Binet scale (below three years of age), or the Stanford-Binet (over three years of age). This is brought out in the work of Hess, Mohr, and Bartelme,[2] who had available over two hundred cases of premature children. Even the children with very low birth weights, 1,500 grams or less, showed practically the same mental development in the early years as those with weights from 2,000 to 3,500 grams. These workers point out that their children had the benefit of special care, both in the hospital and through an out-patient follow-up service. They regarded this special attention as "conducive to optimum conditions for the infants' satisfactory development, both mentally and physically." The findings hold only for premature births that are uncomplicated by intracranial injuries.

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[1] Richards, T. W., and Newbery, Helen: Studies in Fetal Behavior: III. Can Performance on Test Items at Six Months Postnatally Be Predicted on the Basis of Fetal Activity? *Child Development*, 1938, 9, 79–86.

[2] Hess, Julius H., Mohr, George J., and Bartelme, Phyllis F.: *The Physical and Mental Growth of Prematurely Born Children.* Chicago, Ill.: University of Chicago Press, 1934. Pp. xxiii, 449.

CHAPTER IX

THE COURSE OF MENTAL GROWTH

The point at which intelligence begins depends on one's definition of the term. That the newborn infant can learn through a process of conditioning has been demonstrated anew by Irwin and his students.[1] For Sherman and Sherman,[2] intelligence may be said to begin rather early; they believe the sensorimotor responses of the newborn child to be related to the development of intelligence. The appearance of walking and talking is regarded as a sign of mental development.

AGE PATTERNS

Richards[3] has attempted to construct curves of mental growth based on the overlap between mental testing at successive age levels:

> By assuming that the later mental test score represents an increment in performance over the earlier test score, one may, by using r^2, consider the trend line from r_{12} to r_{22} where r_{12} represents the correlation of the first and second tests, and r_{22} represents the self correlation of the second test. A fundamental assumption for this thesis is that mental growth is characterized by an increase in the number of things the child can do. This could mean that certain ability or abilities underlying these performances increase in quality or number. (p. 141.)

Since correlations decrease with an increasing age span, the proportion of a late test present in an early test would decrease as one goes toward the infant measurements. Utilizing the square of the multiple coefficients obtained over various spans, Richards has prepared the composite Figure 8. For this curve, the data from

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[1] Irwin, Orvis C., Weiss, LaBerta A., and Stubbs, Esther M.: Studies in Infant Behavior I. *University of Iowa Studies in Child Welfare*, 1934, 9, No. 4, pp. 174.

[2] Sherman, Mandel, and Sherman, Irene Case: *The Process of Human Behavior.* New York: W. W. Norton & Company, Inc. [c. 1929]. Pp. 227.

[3] Richards, T. W.: A Curve for Mental Growth Based on Overlapping between Age Levels. *Growth*, 1941, 5, 141–147.

Bayley are based on sixty-one infants under three years of age; those from Honzik are for two groups of children ($N = 104$ and 108) who were given two preliminary forms of the California Preschool Scale, ages two to seven years; those from Baldwin and Stecher are based on forty selected children given the 1916 Stanford-Binet. The acquisition of Binet facility appears most rapid from one and a half to six years. On the whole, Richards' results are not markedly different from those published some time ago by Thurstone and Ackerson,[1] utilizing a curve in which the ordinate represented the estimated absolute mean test performance.

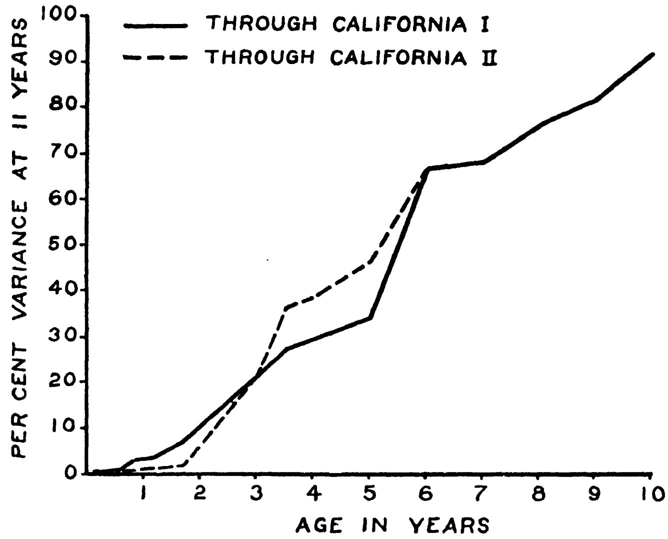

FIG. 8. R^2 Curves Combining Bayley, Honzik, and Baldwin-Stecher Data, Equating at Ages Twenty-One Months and Six Years. (From Richards, p. 146.)

The Infant and Preschool Years

It is clear from the contents of tests available for infancy and early childhood that, if great reliance is placed upon simple motor skills, the items of behavior that can be observed are so meager as to require their inclusion in a maturational concept, whether or not they correlate with subsequent performance in mental testing. Practically there is much to be said for this procedure.

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[1] Thurstone, L. L., and Ackerson, L.: The Mental Growth Curve for the Binet Tests. *Journal of Educational Psychology*, 1929, 20, 569–583.

We shall gain insight as such tests are developed, tried out, and compared with extensive clinical observations. After a few months, the correlations predictive of further growth rise above zero; in the early preschool years they are substantial.

In a recent factorial analysis of Gesell items for children ages six, twelve, and eighteen months, Richards and Nelson[1] have postulated a motor factor and an alertness factor, in addition to a general factor, in order to account for the variance obtained. The alertness factor is related to mental test items beyond infancy. In another study, these authors,[2] on the basis of a sampling of 123 infants, found that items in the Gesell Schedule at the six-months' level could be combined in a multiple coefficient of correlation that would yield fair predictions of Stanford-Binet mental age at the three-year level. However, in a subsequent study[3] they discovered that at twelve months, the Gesell Schedule apparently affords no better prediction of later mental status than at six months. Since at twelve months it is possible to test the rudiments of language, within a few months thereafter a combination of the earlier Gesell items and more language items should serve to improve prediction.

It would be possible to present dozens of "growth curves of intelligence" based, for the most part, on small samplings from the preschool years onward. At the early years, as indicated above, the scores depend largely on simple motor accomplishments. The work of Bayley[4] and Shirley,[5] based on repeated testing, shows on the average fairly steady gains in all the items utilized. The general form of such averaged curves, as for increases in mental age on revisions of the Binet tests, is linear. But the method of choosing and standardizing the test items themselves precludes a knowledge of mental growth over any given interval. We can compare one child with another, or one group with another, or we can retest children and arrive at estimates of difference or progress in relation to the test materials, but we cannot arrange the materials in a curve of growth, from birth upward, that will permit refined observations of the slope of the curve.

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[1] Richards, T. W., and Nelson, Virginia L.: Abilities of Infants during the First Eighteen Months. *Journal of Genetic Psychology,* 1939, 55, 299–318.

[2] Nelson, Virginia Lafayette, and Richards, T. W.: Studies in Mental Development: I. Performance on Gesell Items at Six Months and Its Predictive Value for Performance on Mental Tests at Two and Three Years. *Journal of Genetic Psychology,* 1938, 52, 303–325.

[3] *Ibid.,* III. Performance of Twelve-Month-Old Children on the Gesell Schedule, and Its Predictive Value for Mental Status at Two and Three Years. *Journal of Genetic Psychology,* 1939, 54, 181–191.

[4] Bayley, Nancy: *Mental Growth During the First Three Years: A Developmental Study of Sixty-One Children by Repeated Tests.* Genetic Psychology Monographs, 1933, 14, 1–92.

[5] Shirley, Mary M.: *The First Two Years: A Study of Twenty-Five Babies.* Vol. II: Intellectual Development. Minneapolis, Minn.: University of Minnesota Press [c. 1933]. Pp. xvi, 513.

Honzik[1] (Table 6) presents predictions obtained on the California Preschool Schedules I and II and on Stanford-Binet at ages six and seven. The sampling included 252 children in Berkeley, California, with reliabilities for the California Preschool Schedules (estimated from a previous study of Bayley's) in the middle .90's for the testing of four- and five-year-olds. It can be seen that the California Schedules at twenty-one months give very poor predictions of later mental test performance, but that the predictions become substantial when children are measured after the age of three years. But we cannot jump to the conclusion that the criterion set up for prediction, in this case a later mental age, is itself a valid measure of intelligence. For example, performance at six years fails to "predict" performance at twenty-one months; the question is, which of the two is the more highly saturated with intelligence as defined?

Various types of individual growth patterns in the preschool years are given in Figure 9. Of these, Honzik remarks:

> Case 355 increased from the 1st to the 90th percentile (assuming that the distribution of sigma scores is normal at the various age levels); Case 385 increased from the 31st to the 99.998th percentile. Case 324 in contrast consistently earned one of the highest scores in the group. It is interesting to note how comparatively little her scores vary on the eight different tests. Case 405 is a microcephalic child born to a superior family. She was diagnosed a microcephalic at the age of 21 months. Her scores have been the lowest in the group at every age level. Case 351 represents a fluctuating performance. Other cases could be presented to show a drop in test score followed by a gain. Case 539 scored above the average at 21 months but obtained the second lowest score in the group at 6 years. Her steady decline in mental test performance with reference to the group is disturbingly impressive. (pp. 297–299.)

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[1] Honzik, Marjorie Pyles: The Constancy of Mental Test Performance During the Preschool Period. *Journal of Genetic Psychology*, 1938, 52, 285–302.

TABLE 6[1]

COMPARISON OF THE CONSISTENCY OF MENTAL TEST PERFORMANCE

Age in Years and Months	Test	Number	California Preschool Schedules I and II						Stanford-Binet	
			Age in Years and Months							
			2–0 r	2–6 r	3–0 r	3–6 r	4–0 r	5–0 r	6–0 r	7–0 r
1–9	Cal. I	181	.74 ± .03	.65 ± .04	.58 ± .04	.59 ± .04	.41 ± .05	.39 ± .06	.32 ± .05	.30 ± .05
	Cal. II	73			.46 ± .06	.35 ± .07	.34 ± .07	.42 ± .07	.17 ± .08	.26 ± .08
3–0	Cal. I	153				.77 ± .02	.64 ± .04	.60 ± .04	.57 ± .04	.57 ± .04
	Cal. II	94				.64 ± .05	.46 ± .06	.54 ± .06	.56 ± .05	.54 ± .05
3–6	Cal. I	132					.82 ± .02	.73 ± .03	.63 ± .04	.59 ± .04
	Cal. II	94					.69 ± .04	.68 ± .04	.71 ± .04	.58 ± .05
4–0	Cal. I	121						.71 ± .03	.62 ± .04	.59 ± .04
	Cal. II	102						.71 ± .04	.61 ± .04	.58 ± .05
5–0	Cal. I	108							.67 ± .04	.69 ± .04
	Cal. II	104							.76 ± .03	.76 ± .03

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[1] From Honzik, p. 291.

Cattell[1] scaled various Gesell test items, utilizing standard criteria such as increase in percentage passing, ease of administration, and interest of the child. She found that her tests for three months were "neither very valid nor very reliable." At that age level they did not predict status in Form L of the Stanford Revision at three years. However, the tests at six, nine, and twelve months showed a high reliability, although correlations

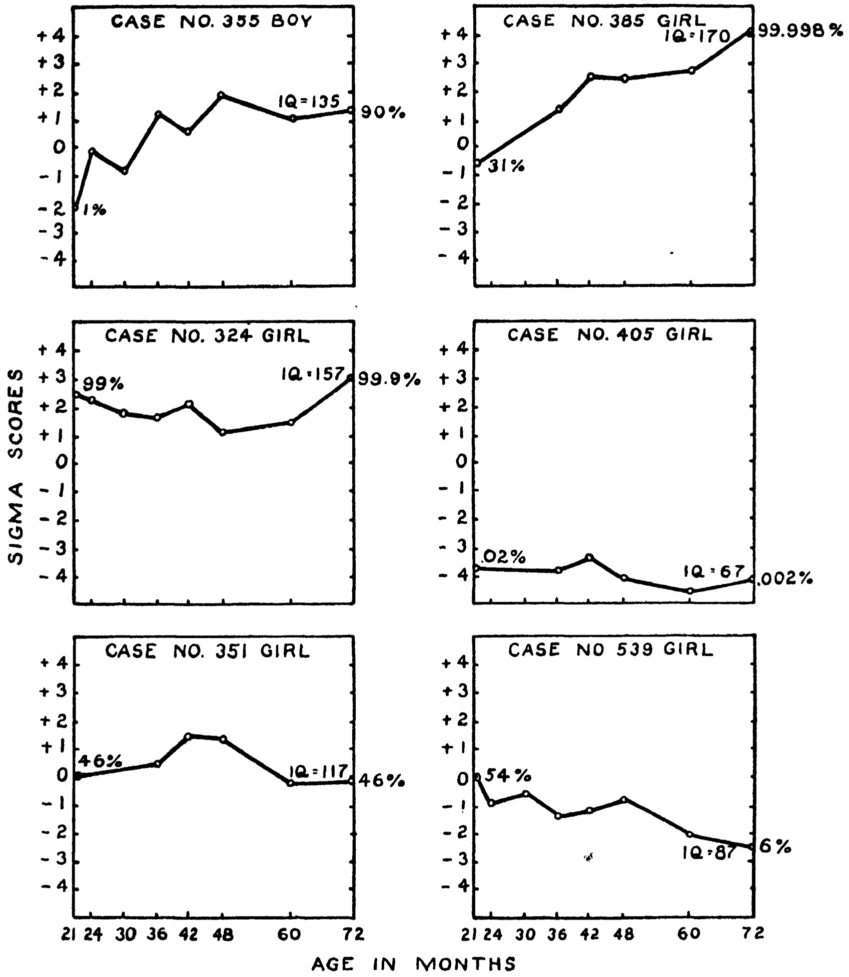

FIG. 9. Constancy of Mental Test Performance for Individual Children. (From Honzik, p. 298.)

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[1] Cattell, Psyche: *The Measurement of Intelligence of Infants and Young Children.* New York: Psychological Corporation, 1940. Pp. 274.

with subsequent Stanford-Binet ratings were low. Of the testing above twelve months, Cattell says:

> A comparison of the I.Q. curves of the older children with those of the infants gives evidence pointing toward the conclusion that a single Infant Test given after the age of twelve or fifteen months gives an I.Q. that predicts future development about as adequately as that of the average of two of the better-known group intelligence tests given to school children, even when the group intelligence tests have been equated to a common standard. (pp. 56, 59.)

Cattell further concludes from her materials that much IQ variation "is the result of changes in the tempo of development rather than the inadequacy of the tests." These "changes in tempo," when found, are firsthand data on IQ inconstancy.

Variations in IQ

Katz[1] analyzed data available for 160 girls and 148 boys in a longitudinal growth study in the Brush Foundation. The sampling was selected on a socioeconomic status, the fathers being professional and business men. These children may be regarded as providing a preschool extension for the Thorndike materials to be presented. On the basis of six-months' test intervals over a child age range of from three to five (1916 Stanford-Binet), Katz came to the following conclusions on IQ stability:

> Approximately 40 per cent of this group of children shows fluctuations of 20 or more IQ points during the period from three to five years. Considerable variation also occurs in the Binet classifications to which children are assigned on the basis of IQ. Only about one-fifth of the group remain in the same classification on four or five tests. While the group upon which this study is based is a highly selected one with regard to socio-economic factors and consequently intelligence, the results agree substantially with those obtained by other investigators. One fact that stands out, however, is the large percentage of children who show significant changes in IQ over a two-year period in spite of fairly high test-retest correlations for the group as a whole. This finding points definitely to a need for caution in judging ability in individual cases on the basis of any single test performance given during the preschool period. When age-to-age correlations are reasonably good there is a tendency to assume greater constancy of IQ than is actually found on analysis of individual records of several examinations. (p. 180.)

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[1] Katz, Evelyn: The Constancy of the Stanford-Binet IQ from Three to Five Years. *Journal of Psychology,* 1941, 12, 159–181.

At all ages, beneath any smooth, composite curve of growth in point-score, mental age, or intelligence quotient, there is a great heterogeneity of progression and regression on the part of individuals. For the IQ, there is a special difficulty arising from its unique relative character. Herring[1] finds the IQ concept so confusing that he prefers what he calls the MQ or mental quotient. This is the rate of change of mental level; it is the individual rate divided by the average rate for a group. the latter presumably of the same chronological age. This quotient will go over 100 as the slope of mental growth for an individual child exceeds that for other children of his age. The quotient, $\frac{MA_2 - MA_1}{CA_2 - CA_1}$, will yield 100 for any child whose mental change is equivalent to the chronological change over the designated interval. If, *at any age*, a child adds three years to his mental stature over a two-year period his mental quotient will be 150. It is as if someone were to ask him, "How are you doing?" and in this case the answer is, "I am doing all right." The IQ is less sensitive to acceleration at the older ages. If a ten-year-old takes on three years of mental growth in two years, his IQ will be $\frac{13}{12} \times 100$ or 108; a three-year-old taking on three years of growth in two years would have an IQ of 120. In the more advanced years the pile up in the denominator (chronological years) and in the numerator (repetition of tests already passed) makes for testing inertia.

It is futile to resist the phenomenon of an easy-changing IQ for the young child. In addition to the arithmetical necessity, there is the probability that growth in intelligent behavior is really more variable in young children. For them we obtain both the lowest and the highest IQ's. It is conceivable that a two-year-old child may pass the tests up through three and a half years, thus giving him an IQ of 175: this happens occasionally. As we go up the age-scale, the construction and standardization of the test make it increasingly difficult to achieve such an IQ, while in the teen ages and beyond it becomes impossible. Here an error has traditionally crept in: an IQ is regarded as indicative of a mental-chronological ratio that will be maintained. We now know that it may or may not be maintained, that an intelligence quotient of 150 is one thing for a five-year-old and quite another for a fifteen-year-old. All an IQ of 150 at age six means is that the six-year-old has passed *scholastic tests* found to be appropriate, on the basis of small samplings, for average nine-year-olds.

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[1] Herring, John P.: The Measurement of Mental Growth. *Journal of Educational Psychology*, 1940, 31, 686–692.

With respect to the "constancy of the IQ," the dictum which dominated the field over a twenty-year period was expressed by Terman in 1919: namely, that the IQ was extremely stable and "that it makes little difference whether the child was bright, average, or dull, how long an interval separated the tests, or what the age of the child was at the earliest test." (p. 140.) [1]

The School Years

It was common practice only ten years ago, upon finding wide fluctuations in the IQ, to postulate almost everything but an actual shift in intelligence to account for the changes. Thus Cattell,[2] on finding a substantial difference on the repetition of Stanford-Binet examinations (for retesting after a lapse of from three to six years, a marked tendency for the low IQ's to become lower and the high IQ's to become higher), made this observation:

> The cause of the gain of the high IQ's and the loss of the low is not clear. The factor of practice is ruled out by the fact that the greater the time interval between the tests, the greater the gain of the bright pupils, and the fact that the pupils of low intelligence lost. The gain in the high IQ's would be accounted for if the upper tests on the Binet scale were too easy, but the reverse has generally been supposed to be true and, in any case, this would not explain the loss of the low IQ's. It may be that the bright child has, or finds, more opportunities to acquire that type of information which aids in successfully passing the Binet tests than the older child of the same mental age. The greater interest in reading of the bright child and the lesser interest of the dull child may be a factor. (p. 548.)

The same interests and opportunities (or their lack) that lead to a higher (or lower) score in the Stanford Revision, and thus to a higher (or lower) intellectual status, if the test is valid, operate as a major factor in *every* obtained score.

Figure 10 [3] is perhaps typical of the IQ variations for large samplings based on the 1916 Stanford Revision. Scores on 1,300 pupils were available over the years 1922 to 1929, yielding a total of 3,331 IQ comparisons. The differences were computed "between the IQ's obtained by each examiner and the other examiners examining the same child." Cattell makes this observation:

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[1] Terman, Lewis M.: *The Intelligence of School Children.* Boston, Mass.: Houghton Mifflin Company, 1919. Pp. xxii, 317.

[2] Cattell, Psyche: Constant Changes in the Stanford-Binet IQ. *Journal of Educational Psychology,* 1931, 22, 544-550.

[3] Cattell, Psyche: Stanford-Binet IQ Variations. *School and Society,* 1937, 45, 615-618.

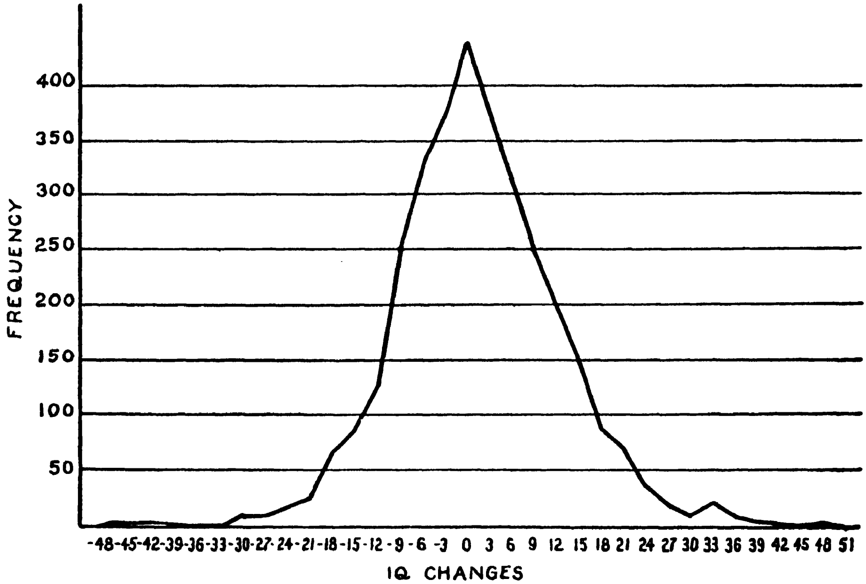

FIG. 10. Stanford-Binet IQ Changes; 3,331 Comparisons. (From Cattell, p. 617.)

> . . . the number and size of the extreme variations are disconcertingly large. Four cases or about one tenth of one per cent. vary over 40 IQ points. One per cent. gained over 30 points, 5 per cent. over 19 points, 10 per cent. over 14 points and 25 per cent. over 7 points. The large losses were less frequent than the large gains. One per cent. lost over 16 IQ points, 5 per cent. over 14, 10 per cent. over 10 and 25 per cent. over 5 points. The median change was + 0.91 and the semi-interquartile range 6.6. Among the variations of 10 points or less the number and size of the gains and losses were almost equal, while among the changes of 10 to 20 points the gains were appreciably more frequent than the losses, namely, 428 and 282 or 12.5 per cent. and 8.5 per cent. The discrepancies between the number of plus and minus variations of 20 points and above was even greater, there being 168 gains and only 55 losses of like size or 5 per cent. and 1.7 per cent. The probable explanation of the preponderance of gains over losses is the inclusion of an undue number of examinations of pupils of superior intelligence. (pp. 617-618.)

While Cattell appears to feel that tests given by different expert examiners will cause a spurious variation in measurement, there is no evidence for this in her report. She found a semi-interquartile range slightly under 7, a figure commonly reported in the literature. (Perhaps the frequent reexamination of the same children by the same examiner could suffer a loss in validity from halo effects.) The only safeguard for reliable measurement, up to the limits of the instrument employed, lies in the designation *expert*, this being as true in mental testing as elsewhere.

In the Thirty-Ninth Yearbook there is a substantial report by Thorndike and others on 1,167 pupils in three well-known New York Schools.[1] In each case, the retesting was carried on after an interval of at least two and a half years. The evidence indicates that selective effects, if any, were slight. The Thorndike materials are presented in Table 7.

The authors say with reference to School B, "There has been a marked gain about comparable to that reported in the Iowa studies. The size of the gain is much too large to be attributed to chance, and the difference between this school and each of the others is also statistically significant." Further analysis indicated that the gain was not cumulative over the years of school attendance, and the authors concluded that it "remained something of a mystery."

In any case, we have established here, for a relatively homogeneous population that is selected mentally and socially and that has been stable enough to stay in the same school over a period of years, *the phenomenon of IQ variation for the best ranges of Binet testing amounting to 20 points, or more, in 16 per cent of the cases.* This then becomes the normal expectancy for the IQ: that it may vary widely, and that we have no guarantee whatever that the obtained IQ for a child will represent his mental status at any later period of his life. We observe that a child can pass from the dull category to the bright, or that a bright child can become dull. Under certain circumstances, a tendency to move upward, on the average, is discernible, and it may be significant.

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[1] Thorndike, Robert L.: Retest Changes in the IQ in Certain Superior Schools. The Thirty-Ninth Yearbook of the National Society for the Study of Education. *Intelligence: Its Nature and Nurture.* Part II. *Original Studies and Experiments.* Bloomington, Ill.: Public School Publishing Company, 1940. Pp. xviii, 409. (pp. 351–361.)

TABLE 7[1]

DISTRIBUTION OF DIFFERENCES BETWEEN INITIAL AND RETEST IQ

Amount of Change (Difference)	*School A*	*School B*	*School C*	*Total*
50	..	2	..	2
45	..	2	1	3
40	2	4	1	7
35	1	9	1	11
30	3	7	5	15
25	3	22	20	45
20	14	31	15	60
15	26	46	33	105
10	42	56	56	154
5	48	62	69	179
0	49	55	72	176
− 5	47	48	71	166
− 10	27	31	65	123
− 15	20	18	42	80
− 20	7	5	9	21
− 25	3	2	3	8
− 30	1	2	1	4
− 35	1	2	3	6
− 40	..	..	1	1
− 45	..	..	1	1
Number	294	404	469	1,167
Mean difference . . .	+ 1.4	+ 6.2	+.7	+ 2.8
S.D.	11.7	13.8	12.4	12.9
S.D. of the mean . .	.7	.7	.6	.4

Lincoln,[2] on the basis of a survey of 109 children, 45 boys and 64 girls, with initial Stanford-Binet IQ's ranging from 119 to 145, showed that over a five- to eight-year period there was considerable change in status. These children were kindergarten and first-grade pupils at the time of first examination. (From another report of Lincoln's,[3] we may judge that the median IQ of this selected group was about 125.) The range was from a loss of 36 IQ points to a gain of 35 points. Forty per cent of the cases changed 10 points or more. Possibly there was a sex difference, as 47 per cent of the boys gained (a median of 8 points), while 33 per cent of the girls gained (a median of 5 points); 51 per cent of the boys lost (a median of 8 points) and 63 per cent of the girls lost (a median of 12 points).

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[1] From Thorndike, p. 355.

[2] Lincoln, Edward A.: A Study of Changes in the Intelligence Quotients of Superior Children. *Journal of Educational Research*, 1935–1936, 29, 272–275.

[3] Lincoln, E. A.: Preliminary Report on the Stanford Binet IQ Changes of Superior Children. *Journal of Experimental Education*, 1932–1933, 1, 287–292.

With some qualification about the constancy of the IQ, even under the best conditions for obtaining constancy, the recent observation of Wheeler[1] is to the point:

> It often happens, to be sure, that intelligence quotients remain constant over a long period of time, and for this reason the constancy of the I.Q. has been accepted as a general law. *It is a law only because the conditions under which children develop remain sufficiently constant to produce a constant rate of mental growth.* There is no reason whatever for asserting that because a child at the age of six has an I.Q. of 60, that he must have only an I.Q. of 60 when he is twelve or fifteen. *Such a claim violates one of the cardinal principles in science, namely, that any event is the product of existing conditions. And conditions can be changed.* (pp. 173-174.)

Similarly, Goldstein[2] holds that educational determinism with respect to the IQ assumes the existence of invariance at a high level — and is false; that is, he regards it as a wrong attempt to carry over from physics and mechanics a principle that does not apply to complex organisms viewed as a whole. Physical and chemical laws apply to structures, compounds, and reactions within organisms, as they do to inorganic material, but, as was noted in Part I, our concepts of intelligence do not deal directly with material at this level of structuralization and organization.

It was suggested earlier that any improvement in testing would probably permit a greater variation, both in the IQ's of individuals and in the averages of populations. This is borne out in some recent data reported by Ebert[3] showing the results of repeating the 1916 and 1937 Stanford Revisions. Since her materials are probably representative of what would be found for other groups of children that are selected on a socioeconomic basis, they are reproduced in Tables 8, 9, and 10.

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[1] Wheeler, Raymond Holder: *The Science of Psychology: An Introductory Study.* New York: The Thomas Y. Crowell Company, 1940. Pp. xviii, 436.

[2] Goldstein, Jacob: Mechanism and Psychoanalytic Theory. *American Journal of Orthopsychiatry,* 1938, 8, 192–213.

[3] Ebert, Elizabeth H.: A Comparison of the Original and Revised Stanford-Binet Scales. *Journal of Psychology,* 1941, 11, 47–61.

TABLE 8[1]

RESULTS OF REPEATED EXAMINATIONS: 1916 REVISION FOLLOWED BY 1916 REVISION

Ages, at Test and Retest	N	M_1	σ_1	M_2	σ_2	$\frac{M_2 - M_1}{\sigma_D}$	r_{12}
5 to 6 years	169	118	14	116	12	1.9	+ .76 ± .02
5 to 7 years	127	119	15	117	12	2.1	+ .75 ± .03
5 to 8 years	86	120	14	117	11	2.0	+ .63 ± .04
5 to 9 years	49	121	12	120	11	.5	+ .56 ± .07
6 to 7 years	127	117	13	117	12	.1	+ .76 ± .03
6 to 8 years	86	118	13	117	11	.8	+ .71 ± .04
6 to 9 years	49	119	12	120	11	.7	+ .66 ± .06
7 to 8 years	86	118	12	117	11	.7	+ .74 ± .03
7 to 9 years	49	119	10	120	11	.9	+ .70 ± .05
8 to 9 years	49	118	8	120	11	1.5	+ .74 ± .04

TABLE 9[2]

RESULTS OF REPEATED EXAMINATIONS: 1916 REVISION FOLLOWED BY 1937 REVISION

Ages, at Test and Retest	N	M_1	σ_1	M_2	σ_2	$\frac{M_2 - M_1}{\sigma_D}$	r_{12}
5 to 6 years	146	116	13	117	14	.8	+ .78 ± .02
5 to 7 years	188	116	13	120	15	5.7	+ .71 ± .02
5 to 8 years	174	116	14	124	17	8.6	+ .69 ± .03
5 to 9 years	120	117	15	125	17	7.1	+ .69 ± .03
5 to 10 years	60	119	16	130	16	6.7	+ .73 ± .04
6 to 7 years	42	114	10	114	12	.4	+ .62 ± .06
6 to 8 years	83	115	11	124	15	7.0	+ .66 ± .04
6 to 9 years	120	115	12	125	17	9.4	+ .76 ± .03
6 to 10 years	60	117	12	130	16	9.6	+ .77 ± .04
7 to 8 years	41	116	11	125	15	4.7	+ .65 ± .06
7 to 9 years	78	116	12	125	18	6.8	+ .80 ± .03
7 to 10 years	60	117	12	130	16	9.6	+ .76 ± .04
8 to 9 years	37	116	13	123	19	4.4	+ .86 ± .03

Also, Figure 11 shows IQ's on consecutive examinations, utilizing the 1916 and 1937 Stanford-Binet tests. It is to be noted, by way of illustration, that a "stabilization" of means over a four-year period, as in the 1916 Revision for ages five to nine years, can go hand-in-hand with a very low prediction of intellectual status for the children involved. Here the respective means for forty-

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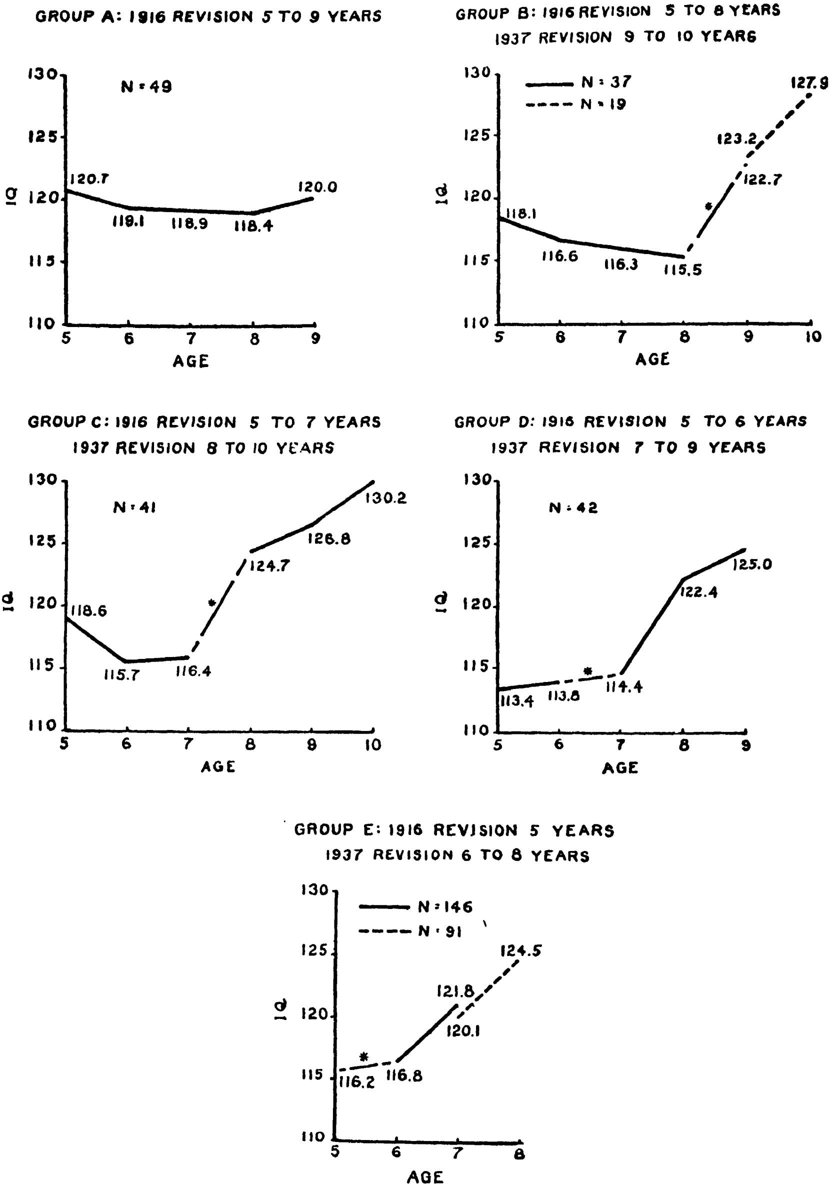
[1] From Ebert, p. 52.

[2] From Ebert, p. 53.



* Broken line indicates transition from 1916 to 1937 revision

FIG. 11. Average IQ's on Consecutive Examinations: 1916 and 1937 Stanford-Binet Scales. (From Ebert, p. 50.)

TABLE 10[1]

RESULTS OF REPEATED EXAMINATIONS: 1937 REVISION FOLLOWED BY 1937 REVISION

Ages, at Test and Retest	*N*	M_1	σ_1	M_2	σ_2	$\frac{M_2-M_1}{\sigma_D}$	r_{12}
6 to 7 years	146	117	14	122	16	6.3	+ .79 ± .02
6 to 8 years	91	116	14	125	18	7.2	+ .78 ± .03
7 to 8 years	133	118	15	124	17	6.6	+ .83 ± .02
7 to 9 years	42	114	12	125	16	7.0	+ .78 ± .04
8 to 9 years	83	124	15	126	16	2.6	+ .86 ± .02
8 to 10 years	41	125	15	130	16	3.4	+ .78 ± .04
9 to 10 years	60	126	18	130	16	3.6	+ .88 ± .02

nine children are 121 and 120, while the correlation between test and retest is $r = .56 \pm .07$. At the same time, in Table 10 for ages six to eight years, a gain of 9 IQ points in the mean is found, although the correlation between test and retest is $r = .78 \pm .03$. In Ebert's data we have a mixture of the effects of practice, regression, differences between two scales, and an actual change in the status of the children being measured. If practice effects in themselves were sufficient causes, we should expect to find them as marked in Table 8 as in Table 10, and this is not the case.

Later Ages

Some early data from Miles and Miles,[2] based on the Otis Self-Administering Test of Intelligence, pick up the trend of test performance in the later decades. Their results are shown in Figure 12. These results are based on a total of 823 subjects from two small cities. It will be seen that the high point of the curve was reached at about eighteen years of age; then there was a fairly rapid decline until, by the age of fifty, the curve has gone back to the early teen-age levels. Here again such factors as speed and the unsuitability of the test materials must be taken into account.

A study by Jones and Conrad [3] is based on the application of

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[1] From Ebert, p. 54.

[2] Miles, Catharine Cox, and Miles, Walter R.: The Correlation of Intelligence Scores and Chronological Age from Early to Late Maturity. *American Journal of Psychology*, 1932, 44, 44–78.

[3] Jones, Harold Ellis, and Conrad, Herbert S.: *The Growth and Decline of Intelligence: A Study of a Homogeneous Group Between the Ages of Ten and Sixty.* Genetic Psychology Monographs, 1933, 13, 223–298.

1,191 Army Alpha examinations to an adult sampling in nineteen New England villages. The age range was between ten and sixty. Figure 13 is a smoothed curve based on the Army Alpha scores. For Army Alpha tests there is clearly a rapid rise to about age sixteen, followed by a peak at about age nineteen. Thereafter we find a smooth decline throughout the older age ranges. Similar data from other studies substantiate the general form of this curve, although its shape is known to vary somewhat with the conditions

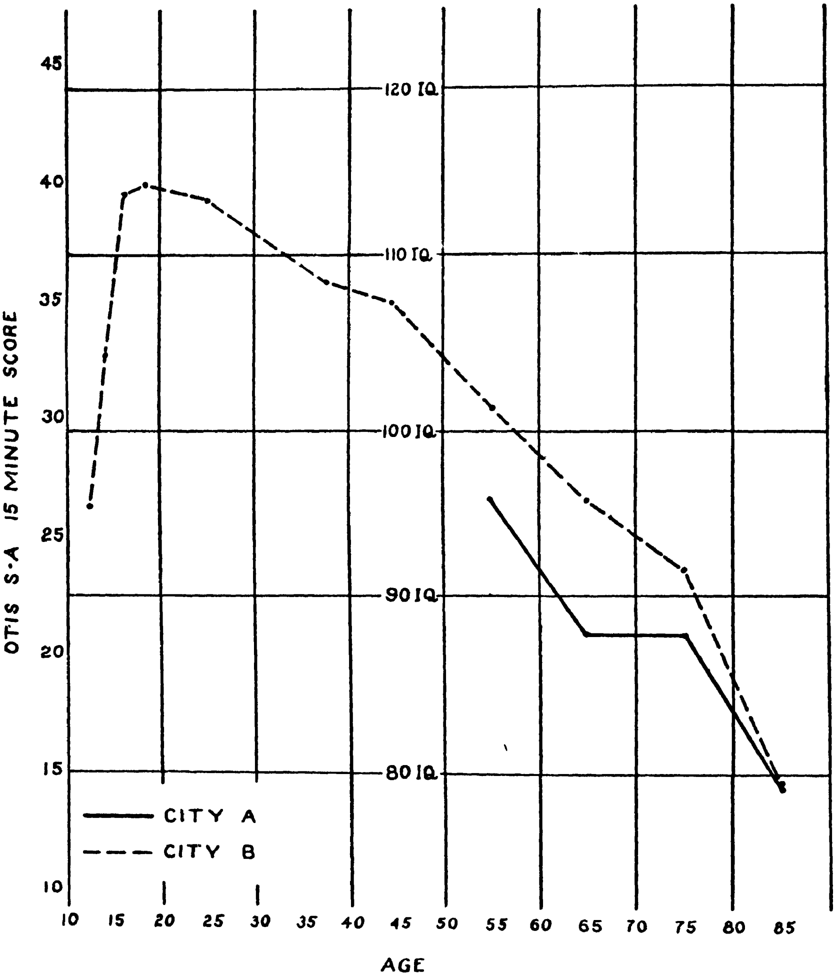

FIG. 12. The Mean Intelligence Scores Plotted by Decades for the Population over Twelve Years of Age Studied in Two Cities with Results for Both Sexes Combined. (From Miles and Miles, p. 51.)

of sampling, motivation, and test administration. Figure 14 shows what would happen if a group mental test were differently constituted, or if different weights were given to its respective parts. It is to be noted that the older persons in this sampling maintained their status in vocabulary and general information.

While Jones and Conrad feel that the tests in which a rapid declination was shown, such as analogies and common sense, were better measures of "basic intelligence" than vocabulary or general information, this cannot be regarded as a defensible position. Rather, it may be, as Gilbert[1, 2] has indicated, that the ability to maintain or increase vocabulary over the years is in itself a measure of a person's resistance to mental deterioration. It must be recalled that, for children, the verbal factors involving vocabulary, general information, and reading comprehension

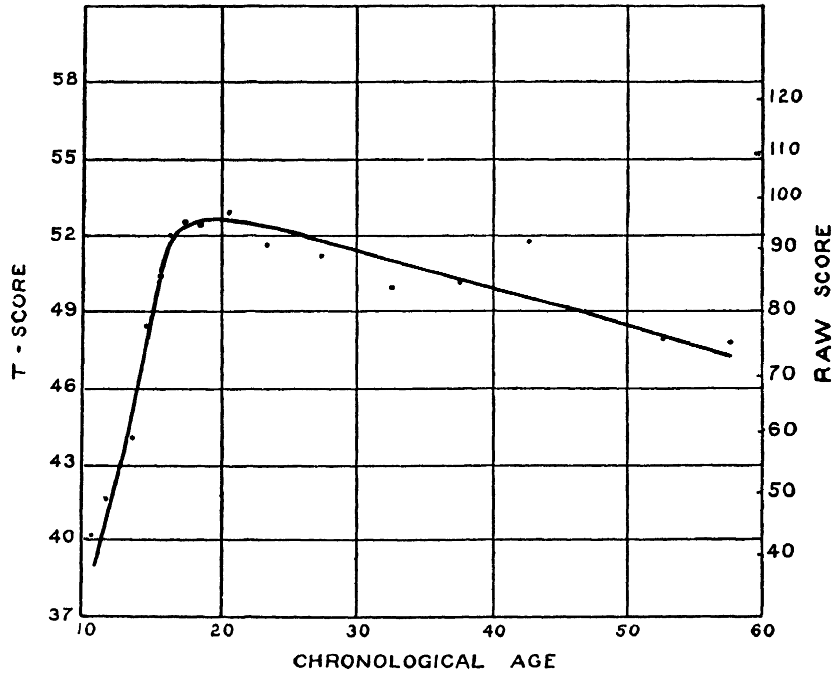

FIG. 13. Smoothed Curve of Growth and Decline of Army Alpha Test Scores of Total Rural New England Sample. (From Jones and Conrad, p. 241.)

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[1] Gilbert, Jeanne G.: Mental Efficiency in Senescence. *Archives of Psychology*, New York, 1935, 27, No. 188, pp. 60.

[2] Gilbert, Jeanne G.: Memory Loss in Senescence. *Journal of Abnormal and Social Psychology*, 1941, 36, 73–86.

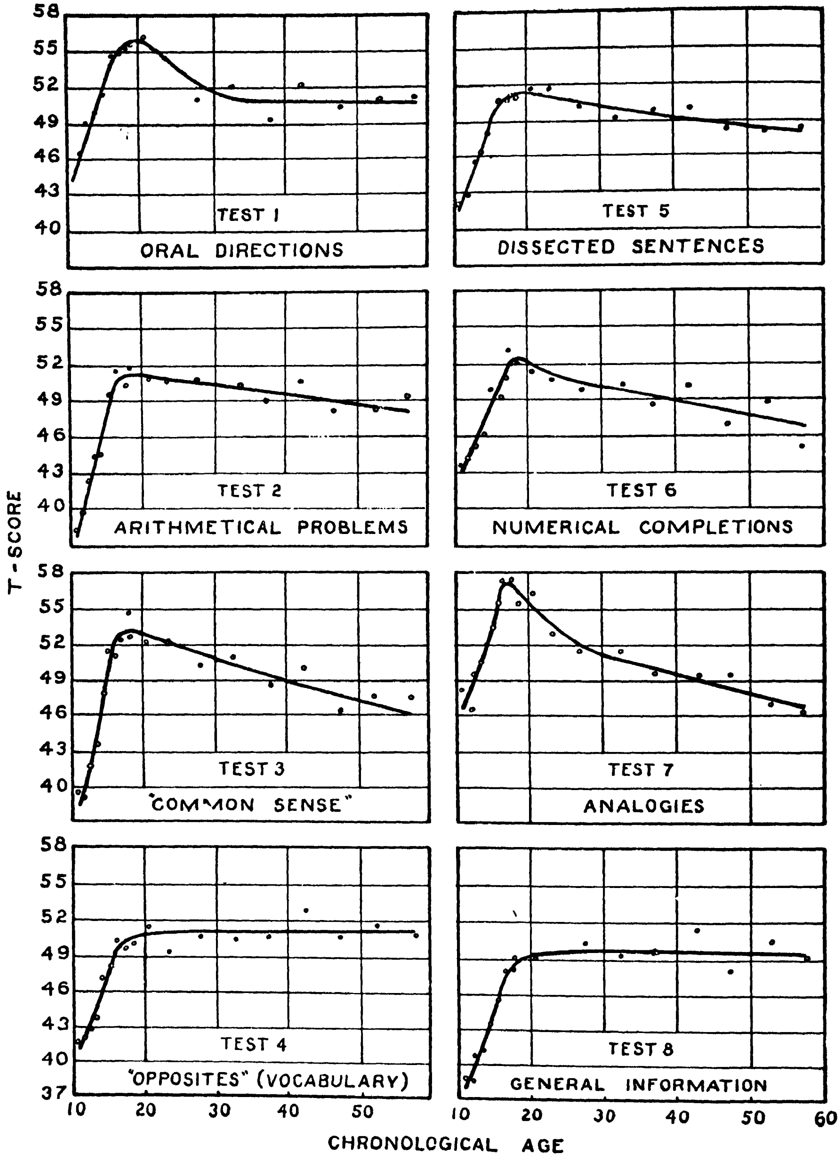

FIG. 14. Growth and Decline in the Individual Subtests of the Army Alpha. (From Jones and Conrad, p. 250.)

make the largest contribution to "intelligence." It may be better to say that adults, in maintaining a given intellectual status, are more dependent than are children upon an *accumulation* of words and ideas. Intelligence is a total summing up and relating process in the world of the abstract; it is not to be revealed in opportunistic subtest abilities that comprise the total structure.

Needless to say, these curves of average performance conceal a vast amount of individual difference. One could select from the data individual curves that correspond accurately to the generalizations, or find others that deviate markedly from the general trend. The only way to find out where an adult stands on a mental test is to persuade him to take it.

Sorenson[1] tested over six hundred students in late afternoon and evening classes at the University of Minnesota, obtaining samples of about seventy-five persons for each five-year age group up to fifty-five years. The tests employed were a one-hour vocabulary test and a reading test chiefly devoted to the comprehension of paragraphs. Vocabulary tended to increase throughout the age range, but there was much fluctuation in the scores based on paragraph reading. The evenness of the median scores in the five-year groups from fifteen to sixty (they are always sixteen, seventeen, or eighteen) and of the median number of items attempted (from 29 to 35), points to a considerable degree of inflexibility in the test employed. Like Jones and Conrad, Sorenson is loath to concede the validity of the contribution of vocabulary to intelligence, although he postulates a relationship between mental exercise and mental ability.

Further evidence on vocabulary is given in a study by Christian and Paterson.[2] A test consisting of 120 vocabulary items was given to freshman students at the University of Minnesota, and to their parents and relatives. The results are given in Table 11. The differences shown are not statistically significant. Moreover there is a selection favoring the younger generation, inasmuch as they are all college students while their relatives presumably are not. Further data indicate that speed is a factor, the younger ones attempting many more items than the older. When this factor is eliminated by scoring only the first half of the vocabulary test (which everyone had attempted), the eighteen-year-olds lose their slight advantage.

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[1] Sorenson, Herbert: Mental Ability Over a Wide Range of Adult Ages. *Journal of Applied Psychology*, 1933, 17, 729–741.

[2] Christian, Alice M., and Paterson, Donald G.: Growth of Vocabulary in Later Maturity. *Journal of Psychology*, 1935–1936, 1, 167–169.

TABLE 11[1]

RECOGNITION VOCABULARY TEST SCORES OF COLLEGE FRESHMEN (EIGHTEEN-YEAR-OLDS) AND PARENTS AND RELATIVES (120-ITEM TEST)

Age Group	*Number*	*Median*	*Standard Deviation*	*Range*
18-year-olds	200	88	17	41–115
40–49-year-olds . . .	50	84	22	40–116
50–59-year-olds . . .	49	82	26	25–115
60–69-year-olds . . .	30	79	29	10–114

ABNORMAL PATTERNS

Babcock[2] has used, as a measure of mental deterioration, the discrepancy between impairment in a person's vocabulary, which is likely to be slight over the years, and impairment of the ability to perform new tasks or take on new learning under timed conditions. In general, her results are consistent with the psychiatrists' observations of the extent and rate of deterioration in their patients. Subsequently, Shipley,[3] following Babcock's lead, prepared a brief, objective self-administering test for measuring intellectual impairment.

Altman and Shakow[4] approached a similar problem from a somewhat different angle. In a study based on normal persons, schizophrenic patients, and adult delinquents, they analyzed the deviation in particular tests when the subjects were matched as to mental age. The deviations found were most pronounced in vocabulary. In relation to their mental age the schizophrenics did somewhat better than the others on the Stanford vocabulary test.

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[1] From Christian and Paterson, p. 168.

[2] Babcock, Harriet: An Experiment in the Measurement of Mental Deterioration. *Archives of Psychology*, New York, 1930, 18, No. 117, pp. 105.

[3] Shipley, Walter C.: A Self-Administering Scale for Measuring Intellectual Impairment and Deterioration. *Journal of Psychology*, 1940, 9, 371–377.

[4] Altman, Charlotte Hall, and Shakow, David: A Comparison of the Performance of Matched Groups of Schizophrenic Patients, Normal Subjects, and Delinquent Subjects on Some Aspects of the Stanford-Binet. *Journal of Educational Psychology*, 1937, 28, 519–529.

Cameron's observations[1] indicate that our emphasis on language has served to deflect potential growth in other forms of symbolization, such as drawing. To quote:

> The same social influences that favor the preservation and compel the enrichment of spoken language condemn drawing to an early stagnation. Drawing is of little use to the active child and as a means of ordinary communication in inter-personal relations. It requires special conditions and special attention; one obviously cannot play running games or walk to school and draw at the same time. It is ill-adapted to find a place in group activities. Contemporaries outside the family circle are rarely considerate of the child's drawings; they are rivals and they ridicule, destroy, or compete disastrously. The satisfaction drawing brings the one who draws pales besides that from the rapidly increasing possibilities of group play. . . . As the social environment becomes increasingly large and complex, the flexibility and the infinite potentialities of spoken language force it more and more to the front, hasten its enrichment and establish it once and for all as the preëminently human social activity. Drawing suffers correspondingly; it is more unilateral where speech is multilateral. It requires special characteristics in the individual to resist this usual social process. Hence it is easier to account for the decline of this form of graphic symbolization than to explain why in the exceptional person it persists and develops into art. (p. 182.)

So great is man's dependence upon language for the richness of his mental growth that analyses that fail to emphasize symbolization may be considered incomplete or distorted. Yet, for the technician in mathematics, physics, chemistry, and the fine arts, a mastery of words may be largely supplanted by other symbolic systems. For our purposes, all these are regarded as language, even though they may be independent of words. To the initiate, there is a hierarchy of abstraction in music and mathematics quite the equal of levels that can be tapped linguistically. While high scientific and artistic talent is normally buttressed by consistent insights in language affairs, this relationship is not needed to establish our premise.

Intelligence is ordinarily measured in verbal terms because they are the common currency, a currency, it is true, that is subject to inflation, deflation, and fluctuation. Under the best conditions of schooling, the intellectual printing presses are worked to capacity and thereafter we face a shortage of new currency in circulation. The congenitally feeble-minded have never known anything but small change, and psychotics persistently confuse the dollar bill and the hundred-dollar bill, finally giving up altogether. The senile who was once "flush" must now be content with a few well-worn dollars per week.

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[1] Cameron, Norman: Individual and Social Factors in the Development of Graphic Symbolization. *Journal of Psychology*, 1938, 5, 165–183.

Psychiatrists have long been impressed with the departure of the neurotic or psychotic person from dependability in mental test performance. It is hard to establish a basal age for him on the Binet scale, and it is hard to tell what his test ceiling may be. Much will depend upon the course and seriousness of his vagaries. For such persons, either the case history or a series of subtests will be more revealing than the ordinary test composites. As Cameron[1] has pointed out, the deteriorated senescent should not be confused with the psychopathic individual who also has lost certain command over concepts and relations. He says:

> Our schizophrenics for the most part have gradually withdrawn from the business of life; they have "retired" long before their time. Most of them have been very unsuccessful in maintaining effective social relationships with the persons and things about them. Our seniles, on the contrary, have been successful in maintaining reasonably adequate social relationships with their personal and material surroundings throughout most of a long life span. Their deterioration has not been a withdrawal from life's stage; on the contrary, they have been unwillingly pushed from it by the defects of their failing machinery. (p. 664.)

In cases involving cerebral injuries, neuroses, and nervous diseases, wide deviations from expected logical sequences are indicated. Superficially, in relation to the number of test items passed or failed, the adult seems to have regressed toward the child; fundamentally he has gotten himself into a mental state that is not characteristic of childhood, feeble-mindedness, or senescence. Weigl[2] found, for instance, that for certain patients only one shade of green in a bundle of skeins would do for the concept *green*. Identical specimens of green were acceptable. If the patient changed his mind, designating another skein as green, he then hunted for another classification for the first shade so designated. That is, if the new green skein is *green,* then the one he had previously selected as green is nongreen; he wants a new name for it! Weigl's patients with frontal lobe injuries exhibited this type of mental blocking.

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[1] Cameron, Norman: A Study of Thinking in Senile Deterioration and Schizophrenic Disorganization. *American Journal of Psychology*, 1938, 51, 650–664.

[2] Weigl, Egon: On the Psychology of So-called Processes of Abstraction. *Journal of Abnormal and Social Psychology*, 1941, 36, 3–33.

Children are somewhat different. In sorting skeins they may imagine a situation or classification and then make choices accordingly. In playing a game they vary the rules as they see fit, developing at least a momentary set of standards. Children may be said to set up scenes on a stage, and then to apply the kind of logic that the scene demands, which is different from standard abstraction. In time children learn to form classes along the most general lines, just as the student of mathematics learns to give general cases: asked to draw a quadrilateral, he will almost never draw a square. The child, in keeping to a normal line of growth and expectancy, shakes himself free from special, discrete, and irrelevant items.

BEHAVIOR PROBLEMS AND DELINQUENCY

All massive social conditions and forces must be regarded as potential sources of variation in the intelligence of individuals and groups. Impoverishment, delinquency, crime, illiteracy, neuroses, and psychoses cannot be simply *caused by* or *causes of* mental inferiority. A few studies and clinical reports may be helpful in clarifying this viewpoint.

On the basis of an elaborate study of the records of 5,000 children observed over a five-year period in a behavior clinic, Ackerson[1] has indicated a rather complex relationship between intelligence and the incidence of behavior problems. The term *behavior problems* was taken to include the maladjustments in conduct and personality that, in one way or another, brought the child before school, clinical, or police authorities. He comes to the hypothesis

> . . . that the interaction of the age factor and the intelligence factor produces the resultant effect of increasing the number of

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[1] Ackerson, Luton: *Children's Behavior Problems: A Statistical Study Based upon 5000 Children Examined Consecutively at the Illinois Institute for Juvenile Research.* Chicago, Ill.: University of Chicago Press, 1931. Pp. xxi, 268.

> behavior problems within the lower age and IQ ranges, and of inhibiting them within the upper age and IQ ranges within our group of children below 18 years of age. It is probable also that either the age factor or the intelligence factor alone, if the other factor were held constant, would likewise produce this "waxing and waning" effect. The process, as far as developmental factors are concerned, is probably a matter of learning and unlearning.
>
> The IQ zones within which the waxing trend changed to a waning trend were not constant, but appeared to vary inversely with age level. Among our children of preadolescent ages the point of inflection was far above the average IQ and among our older children far below the average IQ of unselected children. . . .
>
> In general, the influence of the age and intelligence factors on children's personality and conduct problems, while substantial, is not high. Few of the biserial correlation coefficients for the separate traits studied within our data exceeded .30. Obviously many other constant factors in addition to age and intelligence contribute greatly to children's behavior patterns. (pp. 254–255.)

His IQ distributions of boys and girls, since they are based on a large sampling of children who were carefully observed and measured, may be regarded as not far from a general expectation for the problem children that come before clinics in large cities. (Figures 15 and 16.)

Causal Sequences

From Ackerson's data it would be easy, but fallacious, to hold that low intelligence per se produced the behavior problems and delinquencies. A distribution of the socioeconomic status of these children would show them to be far below average. For these children observed in the clinic, the factors at work are similar to those that yield delinquency and crime in the later years.

Williams remarked,[1] after a survey of recent materials on the relationship between delinquency and intelligence:

> . . . it is concluded that both data and hypotheses are lacking for the demonstration of a direct causal relationship between low intelligence and delinquency, except, perhaps, in particular individual cases. A more reasonable interpretation of the results from mass data is that samplings from inferior groups show a higher incidence

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[1] Williams, Harold M.: Intelligence and Delinquency. The Thirty-Ninth Yearbook of the National Society for the Study of Education. *Intelligence: Its Nature and Nurture.* Part I. *Comparative and Critical Exposition.* Bloomington, Ill.: Public School Publishing Company, 1940. Pp. xviii, 471. (pp. 291–297.)

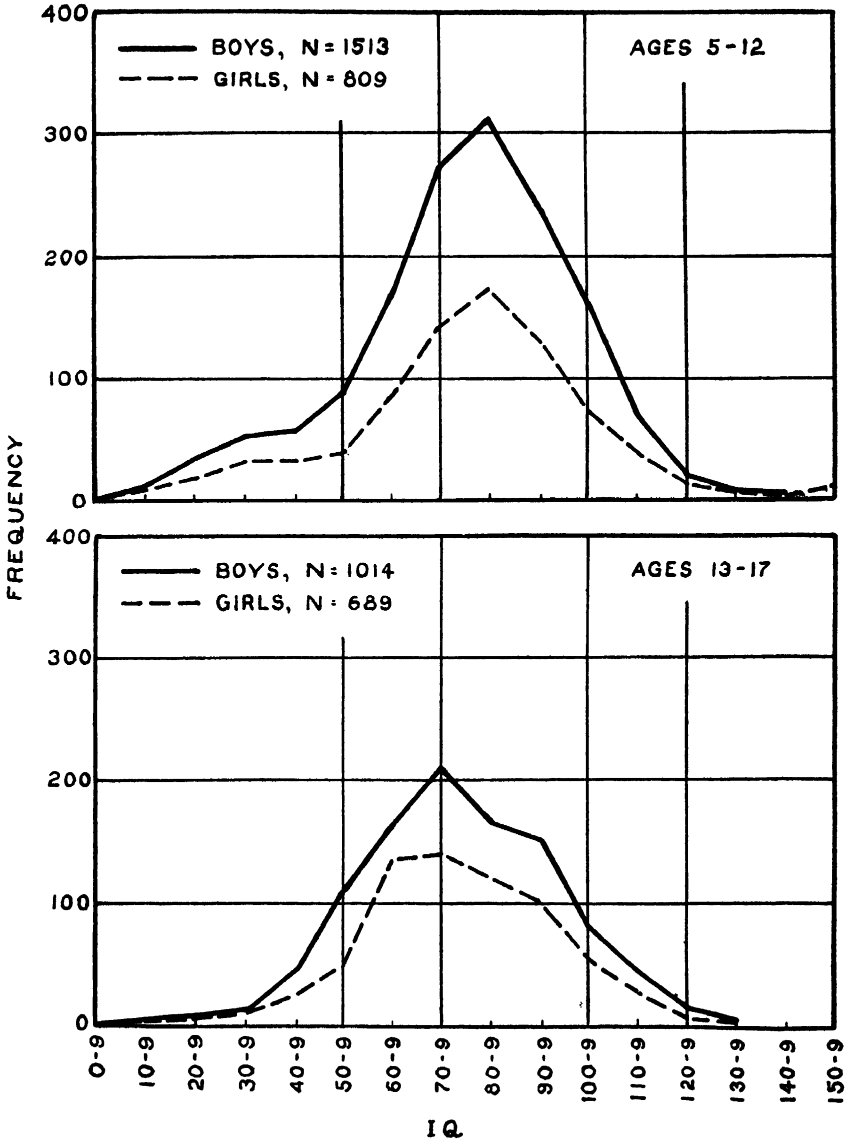

FIG. 15. Frequency Distribution of Intelligence Quotients by Age Groups. (From Ackerson, p. 21.)

of both delinquency and low intelligence. The generalized quality of defect in the underprivileged is familiar to all who have had contact with them. The effects of environmental inadequacies ramify into an extraordinary variety of channels. . . . It may well be that underprivilege, while adversely affecting intelligence through inadequate stimulation, is at the same time disproportionately productive of conditions basic to delinquency. (pp. 296-297.)

To this statement of Williams's, Hollingworth took exception in the Thirty-Ninth Yearbook,[1] as follows:

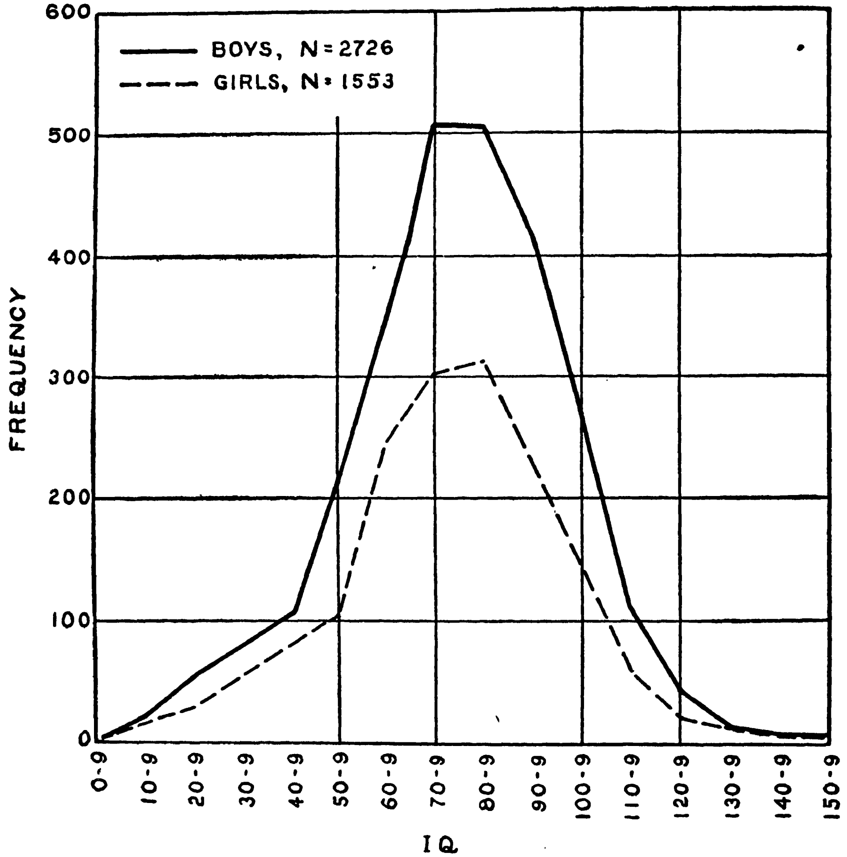

FIG. 16. Frequency Distribution of Intelligence Quotients, Total Group. (From Ackerson, p. 22.)

This conclusion — that there is as yet no evidence that lack of intelligence in itself predisposes to error of the sort that constitutes infraction of law — is perhaps not altogether ruled out by crucial experiment; but certainly formal logic and ordinary inference unite

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[1] Hollingworth, Leta S.: Review of Research. [In] Hollingworth, Leta S., Terman, Lewis M., and Oden, Melita: The Significance of Deviates. The Thirty-Ninth Yearbook of the National Society for the Study of Education. *Intelligence: Its Nature and Nurture*. Part I. *Comparative and Critical Exposition*. Bloomington, Ill.: Public School Publishing Company, 1940. Pp. xviii, 471. (pp. 43-66.)

> in throwing their weight against it. Lack of intelligence leads to all *other* sorts of error; why not to errors of the particular sort that break the law? This is the weight of common sense. Again, wherever delinquents are found, a low level of IQ is found to prevail; and at the same time, a low level of environment in the background. Since lack of intelligence is by definition proneness to error, a very reasonable syllogism runs: low intelligence is a source of error; error leads to poor environment; error leads to infraction of law; therefore, low intelligence causes both poor environment and delinquency, through its characteristic proneness to error. This is the weight of formal logic. (pp 51–52.)

The difficulty with Hollingworth's point of view is that the environment to which the children are responding up through their most plastic years, as expressed in economic status, schools, playgrounds, and general living conditions, is not of their own making. They are given little opportunity to change either the external forms or the rules of the game. Day in and day out, from within the family circle, there is left to each neglected child only an obscure fund of inner resources to which he may turn, finding, if he can, a measure of protection against outrageous attacks upon his physique, health, and personality. The impoverished, underprivileged child is far removed from the grand merging of inner potentialities and upward-pushing experiences that envelop the truly fortunate. The child's family has the greatest control over the immediate environment, and perhaps over the long-run course of events, although, as the economic and social circle widens, it too is caught in a powerful network that may disastrously limit the possibilities of amelioration. Today, no sociologist would think of regarding the "problem child," the "delinquent," or the "criminal" as primarily gene-controlled in his social aberration. He recognizes that certain constitutional inferiorities increase the likelihood of a conflict between the individual and the law, but observes that, for most persons, under decent living conditions and social protections, inherited and acquired factors unite in behalf of social conformity and cooperation.

All persons holding to the theory of a direct, one-to-one, causal relationship between mental deficiency and delinquency should try to explain the wide sex difference. There is ample evidence from the various Binet scales that the two sexes are rated as equivalent in intelligence, while the delinquency ratio usually is heavily weighted toward the male. Ackerson reported that for white children, the ratio of boys to girls in the behavior clinics was about 5 to 3, with no significant differences between the sexes in chronological age or intelligence quotient. McClure,[1] reporting on 600 juvenile delinquents brought before a Toledo court, found the boys to outnumber the girls in the approximate ratio of about 7 to 3. There was no significant difference between the mean IQ's of boys and girls. Statistics of this kind could be piled up. They lead to the inevitable conclusion that strong factors in addition to low mental ratings are at work in producing delinquency. The low average IQ (frequently found in the 80's) shows that there is some kind of association between scholastic aptitude and delinquency; the sharp sex differentiation in the absence of sex differences in test performance, either in the general or the delinquent population, indicates the existence of other connections.

Typical of the retesting of clinical cases is O'Neill's report [2] of IQ variations in 105 children. These were tested, over a two-year period, at the Child Guidance Clinic of the University of Pennsylvania. The chief test was the Stanford Revision, but on occasion the examiner selected Kuhlmann-Anderson, Otis, Thurstone, or Minnesota tests. In thirty cases the IQ varied within 5 points; in twenty-three cases, the IQ increased more than 5 points, and in thirty-six cases, it decreased more than 5 points. In nine cases, the quantitative estimate is lacking for either the first or second mental age, and in seven cases the IQ went up and down. The greatest gain was 31 points and the greatest loss, 36 points. O'Neill, like other clinical workers, is generous in postulating the factors that may serve to disturb the constancy of an IQ (for example, speech blocking, birth injury, behavior problem, disease, glandular dysfunction, and malnutrition). We need not regard these factors as the ones actually at work in producing the changes indicated, for complete evidence is lacking. But O'Neill's data show that a child is capable of wide variations and that it is the habit of a clinician, in accounting for the changes, to observe or postulate physical, emotional, and social factors.

O'Neill's cases, comprising mainly problem children, do not exhibit an unusual amount of IQ fluctuation. A change of 20 points or more was reported for 16 per cent of the children; this happens to be the same percentage that R. L. Thorndike reported for children attending good New York private schools. Some of the factors mentioned by O'Neill are commonly associated with intellectual acceleration or deceleration. Stuttering that involves emotional elements may accompany a loss in intelligence, for it is conducive to scholastic inefficiency and to strong parent or teacher criticism. Learning, by definition, is an adaptation of the organism such that new acts are performed with greater facility. The scholastic achievements expected of the growing child are similar to the increasing demands within the framework of intelligence testing. Similarly an obtained IQ, especially if very high or very low, may provide a basis for emotional disturbances in the child, the tension being mediated through parent-teacher expectations.

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[1] McClure, W. E.: Intelligence of 600 Juvenile Delinquents. *Journal of Juvenile Research*, 1933, 17, 35-43.

[2] O'Neill, H. O.: Variations in the Intelligence Quotient of 105 Children. *Child Development*, 1937, 8, 357-363.

An Illustrative Case

A case from Lowell [1] will serve to show what can happen to individual children. This case is not drawn from the central tendency of school or clinic materials. Happenings of this type, however, are so frequent in the experience of psychologists that they cannot be regarded as artifacts.

> D entered Kindergarten at the age of five years. . . . The first Binet showed such mental immaturity that the child was excluded from Kindergarten for a year. The next year Danny moved into another school district and it was here that the writer made his acquaintance. He had re-entered Kindergarten but had seemed so "queer" that the teacher asked for a Binet. This time he tested *normal*, so he was placed in the first grade in September in spite of his lack of social adjustment. The mother was called in and only then was light thrown on his peculiarities. The teachers had complained that the boy seemed to live in a little world of his own — day dreaming — they called it. He wasn't interested in group activities and was noticeably poor in his motor co-ordination. He had a worried look on his face most of the time and watched the clock with undue anxiety.
>
> The mother explained that while Danny was still a baby his father had developed encephalitis and, of course, could no longer

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[1] Lowell, Frances E.: A Study of the Variability of IQ's in Retests. *Journal of Applied Psychology*, 1941, 25, 341–356.

work. In order for the mother to work they moved to the grandparents' home, where Danny could receive care. Unfortunately, Danny's grandfather was a high-strung, nervous old gentleman who was much annoyed by the child's noise, and expostulated so violently at times that Danny became "petrified" with fear. As a result, he sat on a chair for hours at a time, scarcely breathing, lest it disturb "grandpa." The grandmother's chief aim was to keep things quiet and peaceful at any cost, so Danny paid the penalty. It wasn't until several years had passed that the mother realized her boy was not developing normal habits and interests, and when he was excluded from Kindergarten she decided she must take him away from the grandparents' home. They moved into a different neighborhood and the boy once more entered Kindergarten.

The next few years were a period of educational, social and emotional growth for the starved child. It is not surprising that the child amazed his teachers with his achievement, for a new world had opened up before him. He became an inveterate reader and could solve arithmetic problems far beyond his grade level. Physically frail, he has been under a doctor's care much of the time, and because of his fear complex, he was also treated by a psychiatrist. He made friends with boys in spite of lack of physical prowess. Recently, because of his excellent school work, he was given a fourth Binet and found to have an IQ sufficiently high to warrant placement in a Major Work Group, where he is now enjoying competition with minds as keen as his own.

The fact that these variations occur, regardless of whether the child appears slow or bright at first, seems to indicate that certain factors *within the child,* whether nutrition, a retarded growth at the beginning, glands, an unstable nervous system or what not, modify the child's intelligence. These changes are evidenced by the variations of the IQ. (The IQ's had advanced successively as follows: 82, 98, 111, and 132.) (pp. 353-355.)

RACIAL FACTORS

There is sufficient generality among delinquent and abnormal patterns to make untenable the assumption that each case is purely organic and special. There is a commonality not to be accounted for in terms of the statistical probabilities of a large number of independently varying small events; it is not a kind of coin-tossing. Hence there is vigorous search for larger categories or frameworks within which predictions, as of mental status, may become more reliable. Two of the largest classifications, veritable catchalls of imputed relationships, are *race* and *socioeconomic status.*

It is hardly worth while to rake over the coals of controversy from the results of Army testing in the First World War.[1] Persons familiar with the reports of the mental ratings (on Army Alpha and Army Beta) for recruits will recall that the Negroes made a poorer showing than the whites, but that the northern Negroes were consistently superior to the southern — so much so, in fact, that the average score for Negroes in some northern states was higher than that for whites in certain southern states. It is small wonder that these Army results failed to clarify the main issues. Nevertheless they served to emphasize the supreme negligence of a nation in caring for and developing its greatest social asset, namely, its vast reservoir of human talent.

Brigham's own quietus on certain inferences from this elaborate project, as originally reported,[2, 3] is quoted below:

> If the army alpha test has thus been shown to be internally inconsistent to such a degree, then it is absurd to go beyond this point and combine alpha, beta, the Stanford-Binet and the individual performance tests in the so-called "combined scale," or to regard a combined scale score derived from one test or complex of tests as equivalent to that derived from another test or another complex of tests. As this method was used by the writer in his earlier analysis of the army tests as applied to samples of foreign born in the draft, that study with its entire hypothetical superstructure of racial differences collapses completely. (p. 164.) [3]

It is not an easy thing to demonstrate genuine inferiorities or superiorities associated with racial or national groups. The place of any group on the general socioeconomic scale will vary with the country, the region, and the times. When Negroes are in demand as northern workers, large numbers will go north and thereby improve their cultural and educational opportunities. We can visualize this process in reverse by considering what would happen to a large group of white children from our best residential suburbs if they were transferred to work as casual laborers at low wages in the deep South and were, moreover, expected to conform closely to the scholastic standards of their new environment. While this experiment in migration has not been set up, we have some preliminary evidence on what happens to Negro children when they move north or into improved areas of the South.

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[1] Yerkes, R. M. [Editor]: Psychological Examining in the United States Army. *Memoirs of the National Academy of Sciences.* Washington, D. C.: Government Printing Office, 1921, 15, pp. vi, 890.

[2] Brigham, C. C.: *A Study of American Intelligence.* Princeton, N. J.: Princeton University Press, 1923. Pp. xxv, 210.

[3] Brigham, Carl C.: Intelligence Tests of Immigrant Groups. *Psychological Review,* 1930, 37, 158–165.

Beckham[1] reported, for a sampling of 1,100 Negro adolescent boys and girls, IQ's that averaged from 97 to 101 for the children of families in the upper economic levels, and IQ's in the low 90's for the laboring group. The mean for the total group was 95, with 11 per cent over IQ 109. These averages do not equal those for the children of white persons in the highest occupational groups, but the difference between Negroes and whites is small

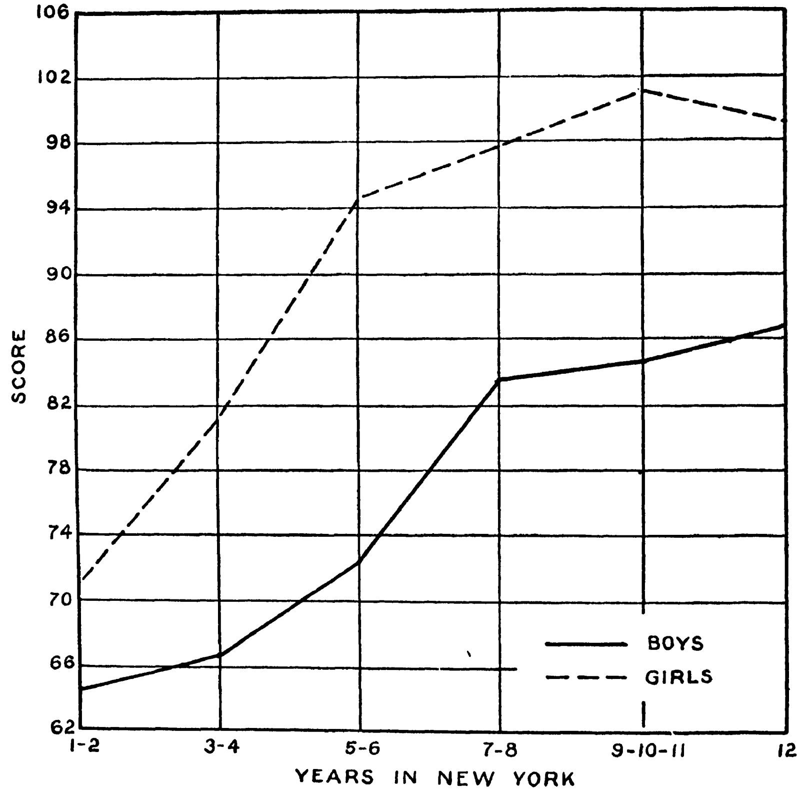

FIG. 17. National Intelligence Test Scores and Length of Residence for Twelve-Year-Old Negro Boys and Girls. (From Klineberg, p. 27, 31.)

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[1] Beckham, Albert Sidney: A Study of the Intelligence of Colored Adolescents of Different Social-Economic Status in Typical Metropolitan Areas. *Journal of Social Psychology*, 1933, 4, 70–91.

in the other occupations. As professional standards for Negroes improve, and there is provision for the finest education of the children in highly selected families, we shall have a better basis for comparing aptitudes.

Klineberg,[1] in a survey preparatory to his main study, was unable to find any selection in the migration of Negro children who had moved from two large southern cities to New York City.

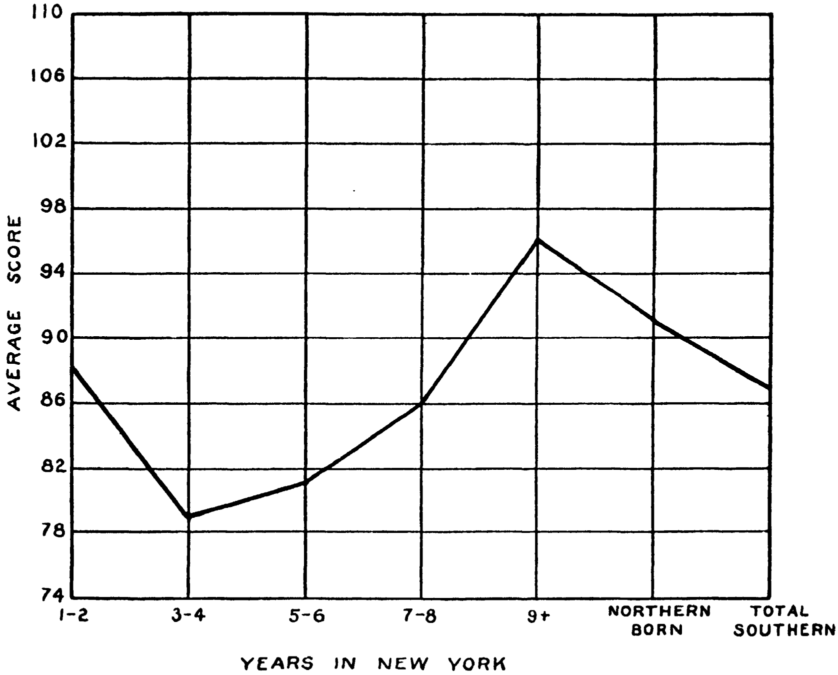

FIG. 18. National Intelligence Test Scores and Length of Residence, Twelve-Year-Old Negro Boys, 1932. (Constructed from data of Marks as reported by Klineberg.)

The distribution of school marks for these migrants was typical of the whole group of Negroes. For 517 twelve-year-old boys measured by Lapidus in 1931, who were in attendance at three public schools and one junior high school, the curve shown (Figure 17) indicates the general tendency to show substantial improvement in scores on the National Intelligence Test. The dotted line represents a comparable curve, based on 619 twelve-year-old Negro girls in Harlem schools tested by Yates.

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[1] Klineberg, Otto: *Negro Intelligence and Selective Migration*. New York: Columbia University Press, 1935. Pp. xii, 66.

From the material given in Klineberg, we have constructed Figure 18. It is based on Marks' investigation of 561 twelve-year-old Negro boys, utilizing the National Intelligence Test.

From the measurements of Skladman and Wallach, who tested ten-year-old girls in the Harlem public schools, and of Rogosin, who tested ten-year-old Negro boys, the combined results shown in Table 12 are obtained:

TABLE 12[1]

STANFORD-BINET INTELLIGENCE QUOTIENTS AND LENGTH OF NEW YORK RESIDENCE, TEN-YEAR-OLD BOYS AND GIRLS COMBINED

Group	*Number*	*Average IQ*
Less than one year	42	81
1–2 years	40	84
2–3 years	40	85
3–4 years	46	89
More than 4 years	47	87
New York born	99	87
Total southern born	215	85

Studies like those of Klineberg and his associates could be used to support a postulate of small differences arising from migration to a community with better scholastic facilities. Changes in the educational standards for Negroes in the cities of origination would affect these results. If, for example, Nashville and Birmingham have in the past ten years improved their educational facilities disproportionately to improvement in New York City, the Klineberg trends could be checked or reversed.

Whether we are considering whites or Negroes, it is not necessary to study a heavy migration in order to show socioeconomic differentials. Within a single city or county, in any part of the country, there are children whose life is a series of negations and impoverishments; in most communities and regions these cultural deficiencies are shared by rather large groups. The essential fact in comparative distributions of test scores and intelligence quotients is the amount of overlapping displayed. Case histories scattered throughout the literature indicate that, in a population of white and Negro children, bright Negro children are not uncommon; they may, like any other children, enter into the highest brackets of intelligence quotients. All races, in order to establish what can be done at the highest levels of intellectual and creative endeavor, must rest their case upon the actual lifetime achievement of superior persons. Hypothetical statements will not suffice. Perhaps all that present-day intelligence testing can do in connection with the racial problem has already been done: it has revealed no basis in scholastic aptitude for discrimination against any race or nationality present in the American population.

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[1] From Klineberg, p. 46.

Where discrimination is not the issue, but rather the discovery of good talent in order to foster it, the search should be conducted in absolute independence of extraneous factors. *The best all-round measurements of intelligence, stability, and special aptitude must be applied directly to the child.* It is of the highest importance that science combine with common sense to disregard race, nationality, economic status, or parentage; so far as the promise of a particular child is concerned, all these are in the realm of "a previous condition of servitude." Lest this language be regarded as dogmatic, we may turn to Jennings:[1]

> . . . It is particularly in connection with racial questions in man that there has been a great throwing about of false biology. Heredity is stressed as all-powerful; environment as almost powerless: a vicious fallacy, not supported by the results of investigation. We are warned not to admit to America certain peoples now differing from ourselves, on the basis of the resounding assertion that biology informs us that the environment can bring out nothing whatever but the hereditary characters. Such an assertion is perfectly empty and idle; if true, it is merely by definition: anything that the environment brings out *is* hereditary, if the word hereditary has any meaning. But from this we learn nothing whatever as to what a new environment will bring out. It may bring out characteristics that have never before appeared in that race. What the race will show under the new environment cannot be deduced from general biological principles. Only study of the race itself and its manner of reaction to diverse environments can give us light on this matter. (pp. 57-59.)

The same difficulties met with in testing Negroes are found in the testing of American Indians, or of tribes and nationalities that depart strongly from present-day white civilization. We need not postulate any anthropological differences greater than those found to realize that proper conditions of testing cannot be met if the object is to make an over-all comparison of the intelligence of different races. It is not just a matter of unfamiliarity with the language or with objects and problems that have become familiar counters to certain classes of children. More subtly, there will be blockings, taboos, and traditions that make the very act of being tested a source of confusion or deceit. As anthropologists like Margaret Mead and Ruth Benedict have pointed out, there are some things that cannot be done in certain tribes without loss of face; the expected answers may not be given to test questions because of possible social embarrassments. We need not explore primitive mentality to guess what would be the reactions of cultured American whites to test questions that were based primarily on sex habits, subvocal speech, or religious belief. If turned in this direction, many a facile adolescent clipping his way through standard verbalized test material would be brought to a confused halt. In any culture, attempts to get at whatever the individual accepts as secret or sinful are met with blocking, evasion, and distortion.

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[1] Jennings, H. S.: *Prometheus or Biology and the Advancement of Man.* New York: E. P. Dutton & Company, Inc., 1925. Pp. vii, 86.

On the basis of group tests of mental ability, Haught[1] reported a mental inferiority for the Indians enrolled in federal schools in Albuquerque and Santa Fe. The estimated IQ's declined from the middle 80's for the early school ages to the 70's for the later ages. Since distributions of this type are comparable to those reported for whites under orphanage and other subaverage conditions, it may be said that Haught left unanswered the difficult questions: What about the home life of these Indian children, the amount of language stimulation available at home and at school, the quality of the schools they attended, and the familiarity with the general type of materials found in group tests? There is no harm in reporting such scores and IQ's, but to say flatly, as Haught does, that these findings give evidence "that the Indians make lower scores than the whites because they are lower in native ability" is not to be established by a simple testing program.

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[1] Haught, B. F.: Mental Growth of the Southwestern Indian. *Journal of Applied Psychology*, 1934, 18, 137–142.

Perhaps workers who have had firsthand contact with various tribes and races would concur in a recent statement of Boas:[1]

> . . . It has been my good fortune to live for a considerable length of time with uncontaminated primitive tribes, and my own observations show that we find among them the same kind of variations of intelligence and of personalities that we find in our own culture — men and women of unusual intelligence and of unusual strength of character as well as weaklings. This agrees entirely with the reports of others who have had similar opportunities. The history of Africa and of America abounds in examples of men who by their intelligence and will power exerted an influence similar to that of the great statesmen of Europe. Intelligence of a people cannot be measured by the traditional background of their culture, but by the observation of the behavior of individuals interpreted on the background of their traditional culture. . . .
>
> My conclusion is that the attempts to construe biologically determined differences in the potential intellectuality of different races are ill-founded, the more so, the larger the groups that are involved; that an experimental quantitative determination of racial intelligence encounters practically unsurmountable difficulties; and that our judgment must be based on the observations of individual behavior with due regard to the cultural background that determines the motivation of action. (pp. 15–16.)

As I have pointed out, if the concept of intelligence were at once universally defined and subjected to completely valid testing, these comparative matters could be eliminated. But intelligence, as it has been measured, or is likely to be measured for some time to come, will be far less than this. In any section of the population, white or nonwhite, it implies only a measure of scholastic aptitude in preparation for a definite program of educational guidance.

SOCIOECONOMIC STATUS

Bayley's data[2] are among the clearest and most recent of the correlations between mental test scores and socioeconomic ratings. They are given in Table 13.

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[1] Boas, Franz: *Evidence on the Nature of Intelligence Furnished by Anthropology and Ethnology.* Addresses and Discussions Presenting the Thirty-Ninth Yearbook of the National Society for the Study of Education in Joint Sessions with the American Educational Research Association and the National Society of College Teachers of Education. Salem, Mass.: Newcomb and Gauss, 1940. Pp. iii, 84. (pp. 11–16.)

[2] Bayley, Nancy: Factors Influencing the Growth of Intelligence in Young Children. The Thirty-Ninth Yearbook of the National Society for the Study of Educa-

TABLE 13[1]

CORRELATIONS BETWEEN MENTAL-TEST SCORES AND FOUR SOCIOECONOMIC RATINGS OBTAINED IN 1928–1929 AND AGAIN IN 1938[2]

Age in Months	*Social Rating*		*Income*		*Occupation*		*Socioeconomic Scale*	
	1928–29	*1938*	*1928–29*	*1938*	*1928–29*	*1938*	*1928–29*	*1938*
1, 2, 3	.02	− .02	− .02	.20	− .14	.05	− .08	.02
4, 5, 6	− .13	− .12	− .07	.03	− .31	− .07	− .28	− .23
7, 8, 9	− .10	− .13	− .06	− .04	− .13	− .01	− .20	− .18
10, 11, 12	− .16	− .12	− .04	.04	− .07	.04	− .23	− .12
18	− .01	.03	.18	.18	.15	.21	− .01	.08
24	.30	.46	.37	.38	.37	.40	.36	.45
36	.04	.22	.15	.30	.31	.39	.13	.29
60	.20	.46	.41	.58	.50	.54	.37	.57
84	.20	.48	.44	.59	.48	.54	.34	.55
96	.27	.49	.52	.61	.50	.59	.46	.62
108	.15	.37	.46	.54	.50	.60	.37	.52
120	.21	.43	.50	.59	.53	.59	.39	.55

Bayley points out that in 1928 many of the parents were young and recently married, whereas by 1938 they were well established in representative occupations. In any case, there is a substantial relationship between family status and child intelligence. The correlations of child intelligence with mother's education, father's education, and mid-parent education were of the same order.

Previously, Bayley and Jones[3] had published similar material, some of which was analyzed in terms of individual growth data. These charts are reproduced below (Figures 19, 20, and 21). As the authors point out, the correlations and growth curves are not to be considered as more than a preliminary description of relationships that may exist; they do not afford an answer to the persistent problems in heredity, maturation, and environment.

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tion: *Intelligence: Its Nature and Nurture.* Part II. *Original Studies and Experiments.* Bloomington, Ill.: Public School Publishing Company, 1940. Pp. xviii, 409. (pp. 49–79.)

[1] From Bayley, p. 56.

[2] The number of cases varies as follows: Social rating, 33 to 38; Income, 35 to 40; Occupation, 44 to 49; and Socioeconomic Scale, 33 to 38.

[3] Bayley, Nancy, and Jones, Harold E.: Environmental Correlates of Mental and Motor Development: A Cumulative Study from Infancy to Six Years. *Child Development,* 1937, 8, 329–341.

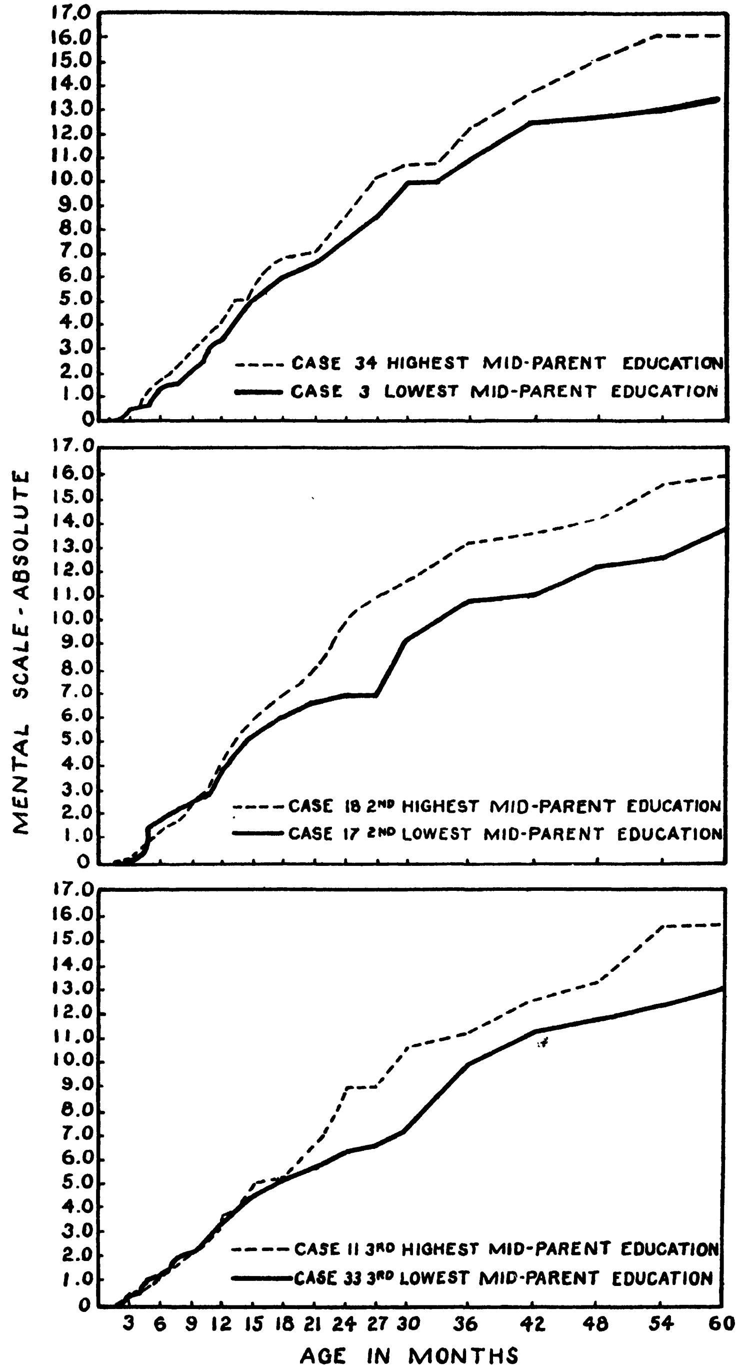

FIG. 19. Individual Curves. High and Low Education. (From Bayley and Jones, pp. 337, 338.)

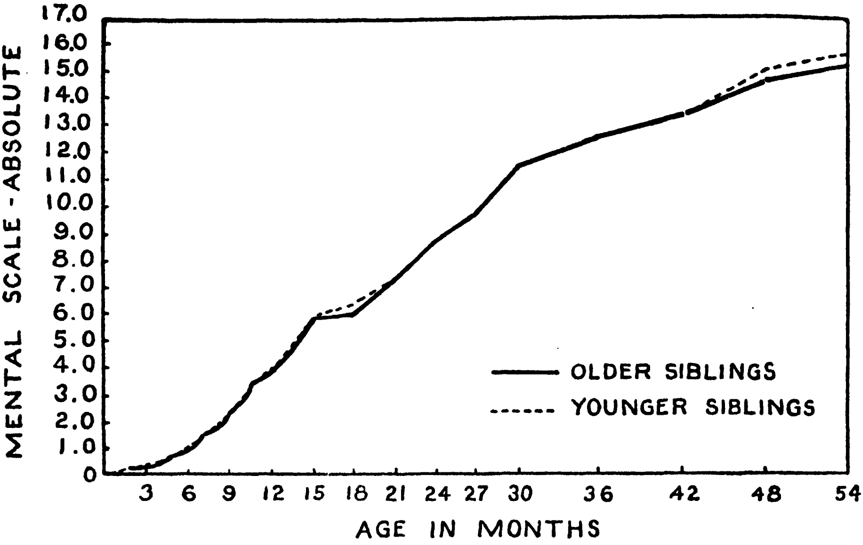

FIG. 20. Mean Curves of Five Pairs of Siblings. (From Bayley and Jones, p. 338.)

On the basis of 252 children, constituting a sampling of the children born in Berkeley, California, and for measurements based on the California Preschool Schedules between the ages of twenty-

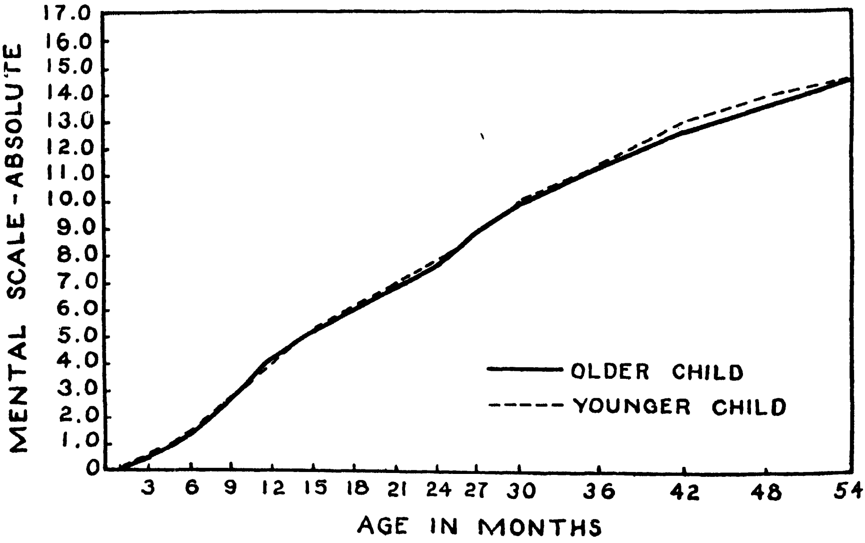

FIG. 21. Mean Curves of Thirteen Unrelated Pairs Matched for Mid-Parent Education. (From Bayley and Jones, p. 338.)

one months and five years, and Stanford-Binet from six years to eight years, Honzik[1] makes the following statements:

> All the parents of children making the most significant gains in mental-test performance had a high-school or college education; whereas 60 percent of the parents of children whose scores decline most markedly during the period 21 months to 8 years had only a grammar-school education. Thus there is a marked tendency for the most significant gains to occur in highly educated families and the most significant losses, in families where the parents are not well educated. . . .
>
> The mother's intelligence, the education of the parents, and a composite socio-economic rating of the home show only a negligible relation to the children's mental-test scores on a first test given at 21 months; but by 3½ years statistically significant relationships were obtained between these family variables and the children's test performance.
>
> Although the most marked gains in relationship occurred between 3 and 3½ years, the relation of the environmental variables to the children's mental-test scores increased up to the last test given at 8 years.
>
> Mid-parent education showed an increasing relationship to mental-test increments, or changes in the children's mental-test scores over the age periods 21 months to 3, 4, 5, 6, 7, and 8 years. The most marked increase in relationship occurred between the third and fourth years. (pp. 201, 203.)

The issue is not whether children may differ markedly from one another at birth or thereafter, for such differences are self-evident. The question is, What factors are at work in relation to the differences? If persons in all levels of ability were to achieve a socioeconomic status directly proportional to their own measured mental ability (a difficult concept, especially for mothers), and if, at the same time, all children were assigned on a chance basis to foster parents, then any correlation between the socioeconomic status of true parents and the intelligence of their children would reflect organic tendencies running across two generations. Any departure from these conditions will affect the ability of persons to get ahead and will influence directly the ability of a child to get a test score. As the more able persons achieve a demonstrably better economic, social, and educational life which, in turn, impinges upon and surrounds their children, we arrive at the most plausible basis of the correlations obtained.

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[1] Honzik, Marjorie Pyles: Age Changes in the Relationship Between Certain Environmental Variables and Children's Intelligence. The Thirty-Ninth Yearbook of the National Society for the Study of Education: *Intelligence: Its Nature and Nurture.* Part II. *Original Studies and Experiments.* Bloomington, Ill.: Public School Publishing Company, 1940. Pp. xviii, 409. (pp. 185–205.)

All considerations of intelligence in relation to the number of children in a family, the ordinal position of a particular child, or of the season of birth are so firmly imbedded in a socioeconomic framework as to preclude a satisfactory analysis. In the United States the largest families tend to be found in the most unfavorably situated economic groups; when there is progress upward from poor social conditions there goes with it a limitation in family size. In comparing large families to small, we have introduced changes in economic status, parental age, and health, together with differential educational permutations as among parents, children, and relatives.

Roberts [1] remarked, after a fairly elaborate study of intelligence and family size, based on a population of 3,400 children in an English city:

> [Between paternal occupation and child score on the Advanced Otis Scale] the correlation coefficient in the case of Group I [the 135 children with the highest mental score] is practically zero, so that in this group there is no association between occupation of father and size of family. This seems to me to be another indication of the complexity of the problem of differential fertility. The occupations of fathers in this group, by the way, are particularly well assorted, and represent adequately all occupational classes from the highest to the lowest. The very bright child whose father is in the lowest occupational group comes from just as small a family as does the very bright child of prosperous parents. The very gifted are, on the average, very infertile, and this is true of all social classes. Apparently we cannot hope that the dying out of the very gifted who belong to the higher social categories will be at least partially made up by greater fertility amongst the very gifted poor. Unfortunately, if our results are representative, the very gifted poor are themselves just as infertile. (p. 246.)

Of course, these parents of "very gifted" children (that is, children of high scholastic aptitude on the Otis Scale) were not themselves known to be gifted at all, even on the Otis test. In view of the restricted validity of mental testing, individual or group, and of the meager data available on the *biological* potentialities of gifted persons, it would be premature to associate brightness with organic barrenness. It is not unlikely that the numerous child-adult contacts available to the only child provide a means for unusual verbal stimulation and educative experience. If large families, at any economic level, are to provide optimum experiences *for each child*, they must devote more time to child rearing and take advantage of special educational ventures, such as nursery schools, kindergartens, camps, and work projects.

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[1] Roberts, J. A. Fraser: Intelligence and Family Size. *Eugenics Review*, 1939, 30, 237-247.

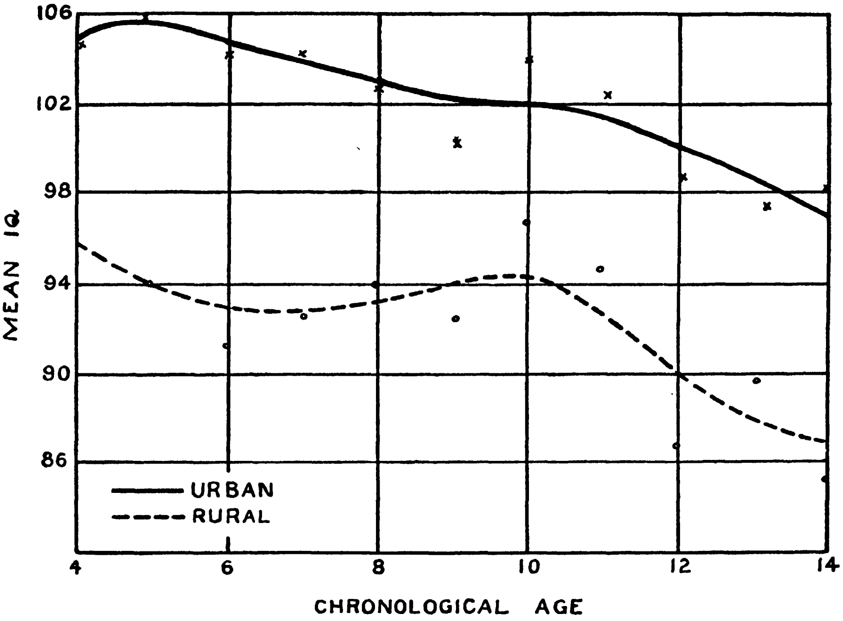

FIG. 22. IQ (1916 Stanford Revision) in Relation to Age: A Comparison of Urban and Rural Samples. (From Jones et al., p. 65.)

RURAL VS. URBAN

In rural sections, the special opportunities for child development have rarely been exploited in behalf of a better *mental* life for farm children. In a study of 351 children in Massachusetts and Vermont, Jones and others [1] prepared a chart that is reproduced above (Figure 22). The rural children in this sampling include children living on farms and in small villages. Other studies over the years have shown a slight inferiority in the mental status of rural children. Baldwin *et al.*[1] reported the Stanford-Binet IQ's obtained for 253 children in seventeen Iowa one-room schools and 425 children in two consolidated schools. The mean IQ for the one-room school children was 92, and for the consolidated, 99. With advancing chronological age, these rural children tended to decrease somewhat in IQ.

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[1] Jones, H. E., Conrad, H. S., and Blanchard, M. B.: Environmental Handicap in Mental Test Performance. *University of California Publications in Psychology,* 1932, 5, 63-99.

Recently, Terman and Merrill [2] have reported, in tabular form, the relation to father's occupation of the L–M composite on the new Stanford Revision (see Table 14).

TABLE 14[3]

MEAN IQ'S (L–M COMPOSITE) ACCORDING TO FATHER'S OCCUPATION

Father's Occupational Classification	*Chronological Ages*			
	2–5½	6–9	10–14	15–18
I. Professional	116	115	118	116
II. Semi-professional and managerial	112	107	112	117
III. Clerical, skilled trades, and retail business	108	105	107	110
IV. Rural owners	99	95	92	94
V. Semi-skilled, minor clerical, minor business	104	105	103	107
VI. Slightly-skilled	95	100	101	96
VII. Day laborers, urban and rural	94	96	97	98

Since tests are standardized on a given population that is likely to be small, and more representative of certain age groups and cultural conditions than of others, they do not lend themselves properly to comparative analysis. The difficulties that are obvious in comparing nationalities, races, and cultural epochs are inherent in any discussion of comparative intelligence within a single sampling of contemporary American children. For example, the term *rural owners* is misleading. In the Middle West the farm owner is an entrepreneur with a large investment; on the West coast his holdings may be smaller and more precarious. *The*

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[1] Baldwin, Bird T., Fillmore, Eva Abigail, and Hadley, Lora: *Farm Children.* New York: D. Appleton-Century Company, Inc., 1930. Pp. xxii, 337.

[2] Terman, Lewis M., and Merrill, Maud A.: *Measuring Intelligence: A Guide to the Administration of the New Revised Stanford-Binet Tests of Intelligence.* Boston, Mass.: Houghton Mifflin Company, 1937. Pp. xi, 460.

[3] From Terman and Merrill, p. 48.

dynamics of rural child inferiority are so little understood that no social problem in this country can be regarded as more pressing. It would constitute a major tragedy if the recent economic upturn for the American farmer were to have no measurable effect upon the health, ability, and professional opportunity of his children.

Waddington [1] has pointed out the kind of data we need:

> We can certainly conclude from this that the genetic differences between the classes are considerably less than their average performances would suggest. But they may not be negligible. Particularly the lowest class of unskilled labourers, who very rarely produce any individuals above the average, may really be genetically slightly inferior. But conditions of labour have so changed recently that many unskilled workers are now recruited from families which used to belong to the skilled class. Perhaps an investigation on children at the same school, some from families which have for generations been unskilled or casual labourers, and others from families which have recently been forced down into this class, would show whether there was a true genetic difference between the two groups. Perhaps also an investigation of the effect of prolonged unemployment of the parents on normal working-class children would reveal the effectiveness of the kind of environmental differences which are found in present-day society. But data on these two points are not yet available. (p. 350.)

We cannot gloss over the situation by maintaining that, if rural children do badly in tests, the tests are therefore inadequate or irrelevant. Inferiorities and superiorities are never to be ruled out because they may be associated with different conditions of life that, on social grounds, are considered equally desirable. For example, if rural children are defective in vocabulary and language and if, at the same time, these abilities are considered germane to a proper concept of intelligence, then rural children will be found inferior in intelligence. Analogously, if the ability to do arithmetic, to see space relations, or to solve mechanical problems belongs in intelligence testing, it should be utilized, irrespective of any advantage accruing to rural children.

THE QUEST FOR CERTAINTY

In summary, it can be said that the search for constancy in the IQ, like the search for the IQ itself, until recently was regarded as a plausible venture; it was supposed to be along the path toward quantitative science. However, among workers who displayed a craving for fixity, for predictions and laws that would hold true throughout a life span and into succeeding generations, there was a failure to recognize the new course of events in physics itself. Scientists in all fields are turning away from a dogmatic concept of cause and effect (supported by observations of great masses or numbers), toward a more individualistic and indeterminate approach. What happens to a particular molecule, atom, or nucleus becomes important in relation to the total complex of conditions and forces impinging upon it at a given moment. In psychology, this movement has been developed in the Gestalt and organismic schools and followed by a recent emphasis upon topology. It is not that the behavior of a molecule or a person is inconsistent with great generalizations, but only that laws must be constructed at a level of abstraction that permits the occurrence of unique events that are experimentally observed. A law defining the behavior of gases during changes in pressure or temperature will be consistent with the violent movements of a particular molecule, but it will not tell much about these happenings.

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[1] Waddington, C. H.: *An Introduction to Modern Genetics.* New York: The Macmillan Company, 1939. Pp. 441.

In psychology, disparate levels of discourse on many occasions have been hopelessly intertwined, there being no better illustration of this than the history of the concept of IQ constancy: some teachers, believing in it, have marked Johnnie, once and for all, as *dull* or *bright.* Clinical and educational psychologists have called upon everything from genealogy to psychoanalysis to explain, or explain away, radical IQ changes, especially if found along a constantly diminishing or accelerating line. *The simple truth is that the IQ, as frequently envisaged, is a myth:* it is *deus ex machina* — something apart from and independent of actual organic and cultural events. The IQ, some feel, is fixed: what varies is the relationship of an individual to it, such variation being a product of invalidity in the test and idiosyncrasy in the child — given a perfect test and an ever-normal child, the IQ would be constant! This view, as we have seen, is untenable, unrealistic, and unnecessary.

CHAPTER X

SEX DIFFERENCES

Under the exigencies of war, we may expect a revival of controversies over the relative abilities of the two sexes. Women will take the place of men in occupations that call for various levels of abstraction or the utilization of special talents and interests. In order to predict how much of this job dislocation will lead to a permanent shift in the occupational habits of women, we shall need to discover and measure the underlying abilities. In the long run, interest may be expected to follow the line of these aptitudes, especially if reinforced by economic and social benefits.

The discussions of sex differences in intelligence found in the literature are not based on strong evidence from tests and measurements, nor are they completely objective. Frequently the purpose is either to justify greater privileges for women along political, financial, and occupational lines or to "keep them in their place." That women can succeed in college, vote, hold successfully most of the occupations previously monopolized by men, manage money and political affairs, and reach the highest levels of intellectual and artistic achievement, is no longer a moot question. It has slowly become apparent that the differences between individuals of a single sex are of greater order than anything related to a class as a whole. Still the general question persists, for it is of theoretical interest, and it may again have bearing upon the organization of a national economy.

THE ABSTRACT AND THE CONCRETE

Is there a sex difference in abstracting ability, in the tendency to turn to categories rather than to concrete behavior? In the past, theoretical *systems* have tended to be masculine, as in religion, philosophy, morality, or physical science; personal, descriptive, functional arrangements, as in lyrical writing, acting, singing, dancing, and person-to-person care have tended to be feminine (or undifferentiated). The man thinks of the good in the abstract; the woman thinks of the good person or the good deed (this is the postulate, not the evidence). The woman loves the baby, the man the idea of a baby.

If there is any such tendency, what conditions it? Is it because of a difference in the kind of contact the woman has with her world, and the man with his? It is not a resultant from the time factor alone, for there are cultural conditions under which women have more freedom, more leisure, or more responsibility for work. Have they then shown a scientific or abstracting aptitude? For example, did the Indian woman, left to do domestic and agricultural chores, develop mechanical means of assistance, as did the men in developing weapons? There may be crossovers in the degree of masculinity in any culture, because the division of labor may not have followed an abstract-versus-nonabstract dichotomy. Laboring men show no great abstracting ability. Science has some concrete divisions of labor, and the different branches of science do not make equally abstract demands.

We can entertain the hypothesis that men are the verbal, mathematical, and scientific web-spinners, while women are workers in the here-and-now, in the concrete person-to-object and person-to-person relationship, developing not so much the theoretical systems as the personal arts. This disjunction would be valid even though the total weight of factors were cultural. Should it run across many cultural conditions, the probability increases that we would have a difference that is related to anatomical, physiological, and neurological differences as between men and women.

RESULTS FROM MENTAL TESTS

The simplest point of departure in a discussion of sex difference is to sample the results that have been obtained with standard mental tests. Below are given, from Freeman and Flory,[1] some curves based on the VACO tests (vocabulary, analogies, completion, and opposites) previously described. These figures are based on all the boys and girls between the ages of eight and seventeen who were included in the study by Freeman and Flory.

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[1] Freeman, Frank N., and Flory, Charles D.: Growth in Intellectual Ability as Measured by Repeated Tests. *Monographs, The Society for Research in Child Development*, 1937, 2, No. 2 (Serial No. 9), pp. xi, 116.

It appears unlikely that the slight divergences of one curve from another indicate a genuine difference between the sexes.

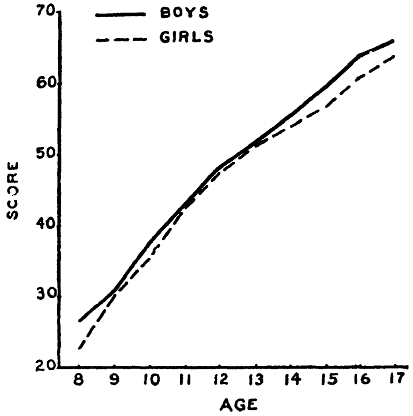

FIG. 23. Mean Vocabulary Scores of Boys and Girls. (From Freeman and Flory, p. 45.)

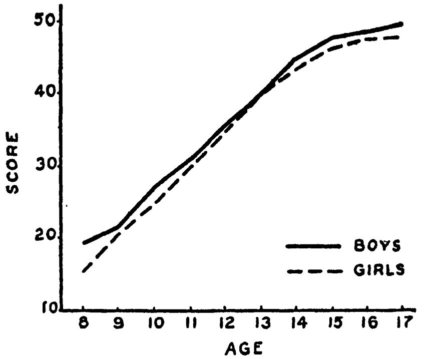

FIG. 24. Mean Analogies Scores of Boys and Girls. (From Freeman and Flory, p. 44.)

In the materials cited from Jones and Conrad,[1] two curves based on the Army Alpha test are available. Figure 28 shows a fairly

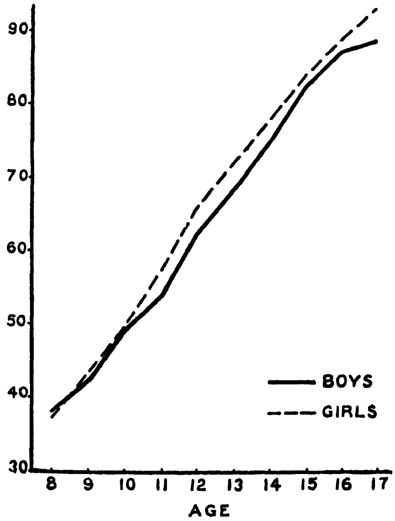

FIG. 25. Mean Completion Scores of Boys and Girls. (From Freeman and Flory, p. 45.)

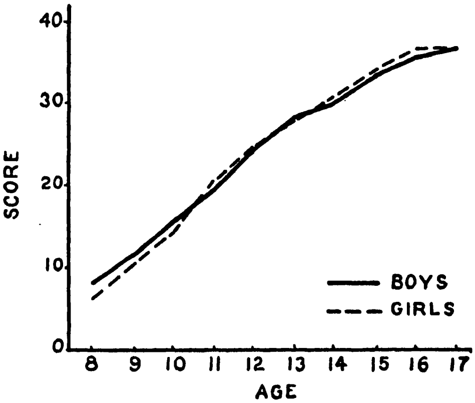

FIG. 26. Mean Opposites Scores of Boys and Girls. (From Freeman and Flory, p. 44.)

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[1] Jones, Harold Ellis, and Conrad, Herbert S.: The Growth and Decline of Intelligence: A Study of a Homogeneous Group Between the Ages of Ten and Sixty. *Genetic Psychology Monographs*, 1933, 13, 223–298.

substantial advantage of males over females in arithmetic problems (Army Alpha), and Figure 29 shows the reverse situation with respect to the analogies test. In a follow-up study of these materials which, in the aggregate, involved the giving of the Army Alpha test to 581 males and 607 females between the ages of ten and sixty, Conrad *et al.*[1] conclude:

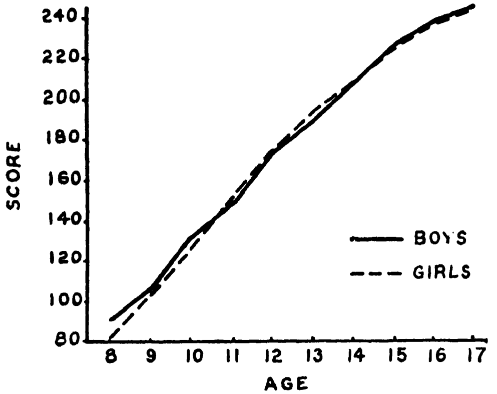

FIG. 27. Composite VACO Curves from the Mean Scores of Boys and Girls. (From Freeman and Flory, p. 44.)

> A general slight superiority of females to males is observed; this superiority (as in physical growth curves) is greater during early adolescence, but is at no age sufficiently marked to be of great practical significance. The sex difference is by no means uniform among the individual subtests of the Alpha. In four strongly verbal tests ("common sense," opposites, disarranged sentences, and analogies), the males are rather consistently inferior; in two tests (numerical completions and general information), the sex differences are relatively slight, with frequent intersections of the developmental curves; in one test (arithmetic problems), the males are quite definitely superior. (pp. 167-169.)

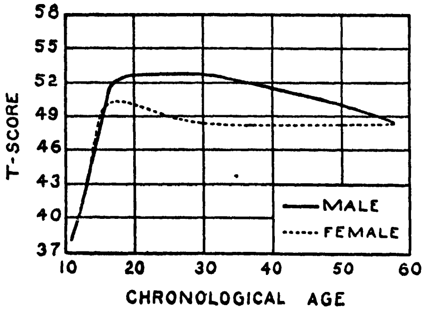

FIG. 28. Growth and Decline of Ability in the Arithmetical Problems Subtest of the Army Alpha. (From Jones and Conrad, p. 250.)

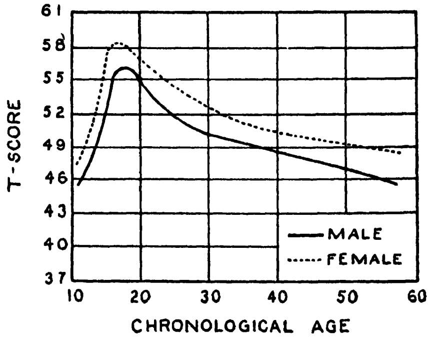

FIG. 29. Growth and Decline of Ability in the Analogies Subtest of the Army Alpha. (From Jones and Conrad, p. 250.)

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[1] Conrad, H. S., Jones, H. E., and Hsiao, H. H.: Sex Differences in Mental Growth and Decline. *Journal of Educational Psychology*, 1933. 24: 161-169.

While Jones and Conrad thought that the sex difference in arithmetic arose from "differential practice and mental attitude," a view which may be said to prevail, there is really no evidence for this. Up through the elementary school, there is no stigma attached to arithmetic and no special premium on English that would make for sex divergence; nor is there, at these elementary stages of a subject, much likelihood that pupils or teachers look forward to a difference in vocational applicability. In the high school there appears to be no sound reason, except within the abilities and choices of the persons concerned, to expect women to teach English and men, mathematics.

Sex differences from the study by Miles and Miles[1] based on the Otis Self-Administering Test of Intelligence are given in Figure 30. (The Otis test, like the Army Alpha, is a brief and highly verbalized test in which speed is a factor.)

In Heilman's investigation [2] the subjects were ten-year-old children in the public schools of Denver, the age range being only from ten years and one month to ten years and ten months. The sampling included all the cases of American parentage in forty-eight different schools for whom complete records were available (482 girls and 464 boys). Utilizing the Stanford Achievement test, he was unable to find significant differences between boys and girls, except for spelling and language usage, in which the girls excelled, and for arithmetical reasoning, nature study, and science, in which the boys excelled. Possibly the boys were also better in history and literature, but all differences, with the exception of spelling, may be considered minor. Heilman's comment is of interest:

> An examination of nine articles on sex differences in various intellectual traits revealed many deficits. . . . If it be assumed that to make a reliable study of sex differences in intellectual functions, the sex groups should be equalized on the basis of training, life age and socio-economic status; that for each age there should be at least one hundred subjects of each sex; that the distribution should be normal; and that there should be a statement of the standard error of the difference, then four of the nine studies are

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[1] Miles, Catharine Cox, and Miles, Walter R.: The Correlation of Intelligence Scores and Chronological Age from Early to Late Maturity. *American Journal of Psychology*, 1932, 44, 44–78.

[2] Heilman, J. D.: Sex Differences in Intellectual Abilities. *Journal of Educational Psychology*, 1933, 24, 47–62.

deficient in five of these six requirements, three in four of them, and two in three of them. While the investigation to be reported in this article is not free from faults, it is believed that it is far superior to the nine investigations discussed as well as to almost all others made to determine sex differences in intellectual traits. (pp. 47–48.)

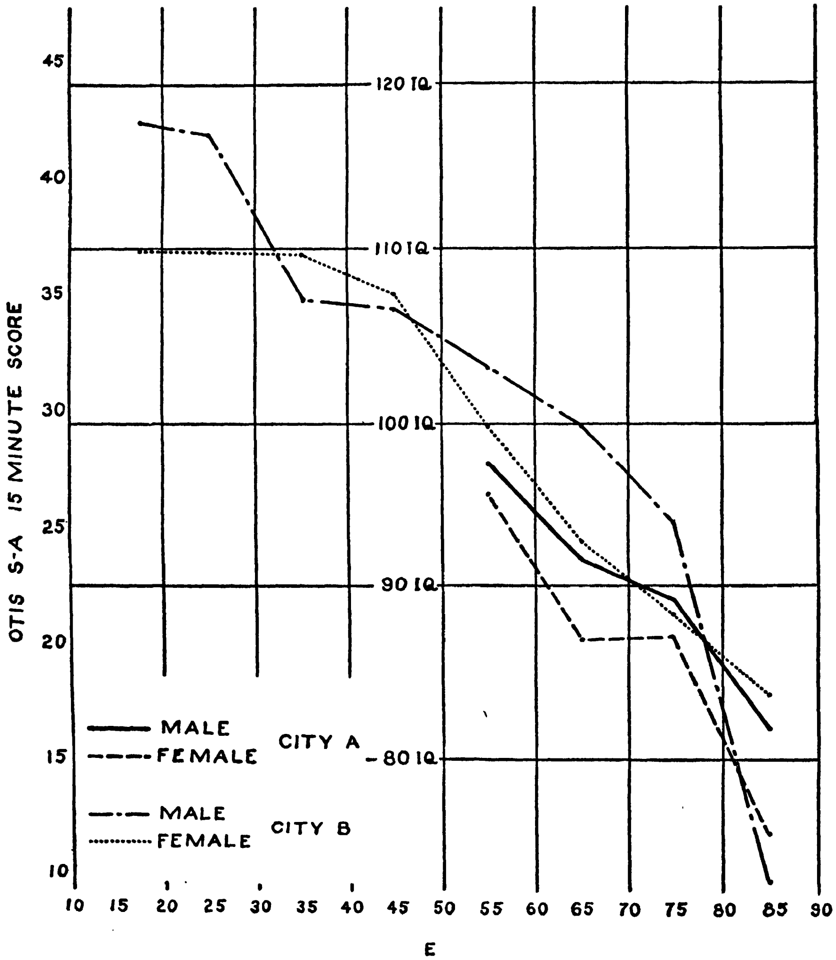

FIG. 30. Distribution of Mean Intelligence Scores by Sexes and by Decades. (From Miles and Miles, p. 69.)

For a group of 261 boys and 200 girls in grades 4 to 8 in New York public schools who were about equal (somewhat above average) on the basis of the Otis Intermediate Group Test, the Army Beta Test, and the Army Individual Performance Test, Armstrong[1] obtained a few reliable differences on subtests. The boys were significantly superior to the girls in these Beta items: maze, cube analysis, picture completion, and geometrical construction, while the girls were probably superior in the number-checking test. In the Army Individual Performance Test, the boys were superior in the ship and maze subtests. For this sampling, other differences were not found to be reliable.

In the study by Garrett and others referred to previously,[2] based on school samplings of boys and girls at ages nine, twelve, and fifteen, the only difference that reliably favored the boys was in the arithmetic test at age fifteen, while the girls appeared reliably superior at all age levels in "making gates," memory for objects, logical prose, and word retention. The authors felt that the logical prose selection and the objects (chiefly household articles) may have been more appealing to girls than to boys.

We can imagine another type of comparison based on a coupling of two factors, the second of which is an assumption so far as American elementary-school children are concerned. We have seen that the intelligence measured in a composite of group or individual tests, or in any one of the subtests, is influenced by what happens to the child; if these happenings take place differentially with respect to the two sexes, then one will draw away from the other, even though potentially the two were equivalent. As in other departures from expected patterns, we should not need to postulate more than slight organic or social differences in order to find, as an end result, rather wide differences in the intellectual aptitudes, interests, and achievements of the two sexes.

College Students

Livesay[3] cites data based on the scores of 505 males and 372 females who were given the American Council Psychological Examination. His was a composite racial group that included Caucasians, Chinese, Japanese, and part-Hawaiian, comprising freshman applicants at the University of Hawaii. Reliable differences were found, as follows: (1) for the group as a whole, comprising all the races, it is almost certain that the males excel in arithmetic and the females in artificial language, and probable that the males are superior in analogies; (2) for the Caucasians, males are better than females in arithmetic, and poorer in artificial language; (3) the Chinese males are better than Chinese females in arithmetic and analogies; (4) the Japanese males are better than Japanese females in arithmetic, and poorer in artificial language; (5) the part-Hawaiian males are better than part-Hawaiian females in arithmetic. While the two sexes may not have been equally selected at these high levels of ability, it seems unlikely that this would account for all the differences found.

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[1] Armstrong, Clairette P.: Sex Differences in the Mental Functioning of School Children. *Journal of Applied Psychology*, 1932, 16, 559–571.

[2] Garrett, Henry E., Bryan, Alice I., and Perl, Ruth E.: The Age Factor in Mental Organization. *Archives of Psychology*, New York, 1935, 26, No. 176, pp. 31.

[3] Livesay, T. M.: Sex Differences in Performance on the American Council Psychological Examination. *Journal of Educational Psychology*, 1937, 28, 694–702.

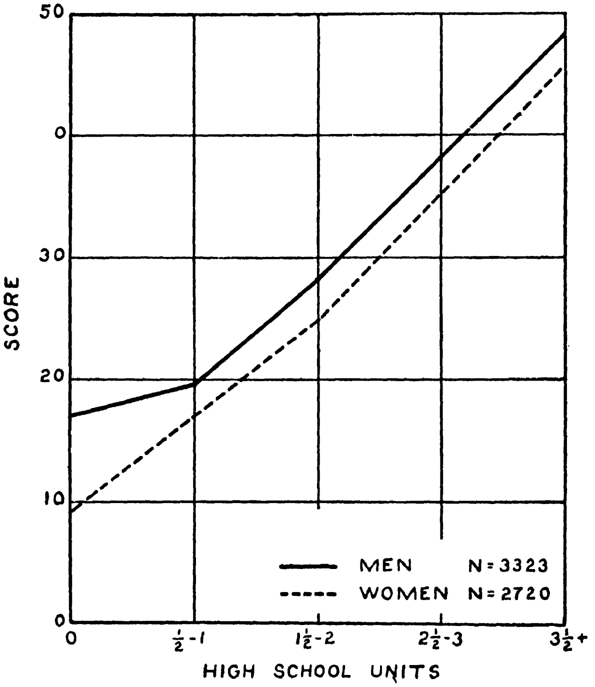

FIG. 31. Comparison of Scores on Mathematics Section, Iowa High-School Content Examination, Form B, for Beginning Freshmen in California Junior Colleges According to Number of Units of High-School Mathematics Taken. (From Eells and Fox, p. 383.)

Eells and Fox[1] have reported on sex differences in mathematical achievement for six thousand students in forty-seven California junior colleges. They used the mathematics section of the Iowa High-School Content Examination, Form B. These materials do not go beyond the elementary stages of the subject. The data may be considered stable for the conditions outlined. Their main findings are presented in Tables 15 and 16. This difference is highly significant, being over forty times its PE. The two sexes were equal in general mental ability, the means on the Thurstone Psychological Examination being 138 for men and 137 for women. For men, the Pearson coefficient of variability is 43, and for women, 49. Table 16 presents an analysis of the differences, with an equating of the amount of high-school mathematics taken by the two sexes. The data in Table 16 are shown graphically in Figure 31.

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[1] Eells, Walter Crosby, and Fox, Clement S.: Sex Differences in Mathematical Achievement of Junior College Students. *Journal of Educational Psychology*, 1932, 23, 381–386.

TABLE 15[1]

COMPARISON OF SCORES ON MATHEMATICS SECTION, IOWA HIGH-SCHOOL CONTENT EXAMINATION, FORM B, FOR BEGINNING FRESHMEN IN CALIFORNIA JUNIOR COLLEGES

	Number of Cases	*Mean*	*Sigma*	*PE of Mean*
Men	3323	34.7	14.9	0.2
Women	2720	25.2	12.3	0.2
Difference		9.5 ± 0.2		

TABLE 16[2]

COMPARISON OF SCORES ON MATHEMATICS SECTION, IOWA HIGH-SCHOOL CONTENT EXAMINATION, FORM B, FOR BEGINNING FRESHMEN IN CALIFORNIA JUNIOR COLLEGES ACCORDING TO NUMBER OF UNITS OF HIGH-SCHOOL MATHEMATICS TAKEN

Units	*Men*			*Women*			*Difference*	
	Number	*Mean*	*PE*	*Number*	*Mean*	*PE*	*Amount*	*PE*
0	96	17.0	0.9	106	8.9	0.4	8.1	1.0
½–1	274	20.2	0.4	371	17.2	0.3	3.0	0.5
1½–2	1254	28.5	0.2	1679	25.0	0.1	3.5	0.2
2½–3	901	38.5	0.3	433	34.4	0.4	4.1	0.5
3½ and over	798	48.7	0.3	131	47.3	0.8	1.4	0.9
	3323			2720				

---

[1] From Eells and Fox, p. 382.

[2] From Eells and Fox, p. 382.

Controlling the age factor, Eells and Fox assembled materials that are shown graphically in Figure 32.

For a sampling of the students, Eells and Fox also made an analysis of responses to individual test items. While the men worked slightly faster than the women, it was found that the percentage of correctness in seventy out of seventy-five items favored the men, and in four additional items the difference was too small to be significant. In only one item was there a slight difference in favor of the women; this was a question in plane geometry relating to concentric circles. Below are listed ten problems from the mathematics section of Form B of the Iowa test in order to illustrate the kind of materials for which these differences were found. (The whole section of seventy-five items has a reliability of .93 for high-school graduates.)

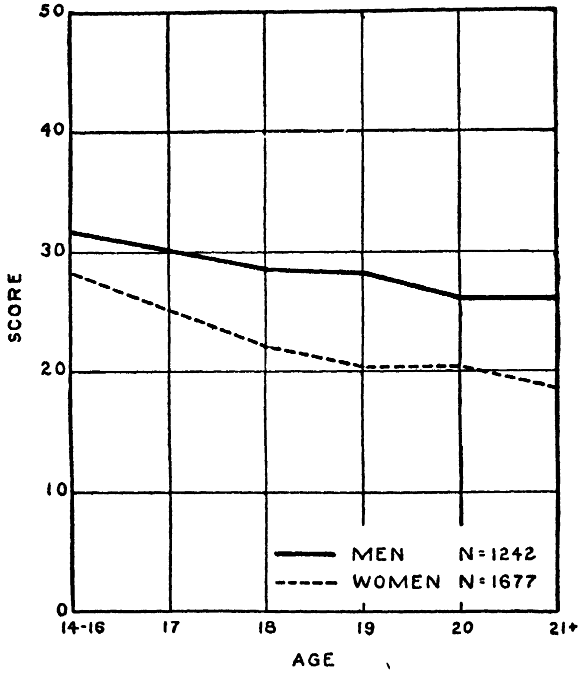

FIG. 32. Comparison of Scores on Mathematics Section, Iowa High-School Content Examination, Form B, for Beginning Freshmen in California Junior Colleges According to Age of Student. (From Eells and Fox, p. 384.)

An algebraic fraction is (1) .6 (2) 12/5 (3) $3\,a/b$
(4) 1/8 (5) $4\,mn$ ____

The exponent in the term $26z^3$ is (1) 3 (2) z (3) 26 (4) z^3 (5) $26z$ ____

$(m+n)^2 =$ (1) $m^2 + 2mn + n^2$ (2) $m^2 + n^2$ (3) $m^2 + mn + n^2$ (4) $2m^2 + 2n^2$ (5) m^2n^2 ____

The square root of $y^2 - 2yz + z^2$ is (1) $y - z$ (2) $y + z$ (3) $-2yz$ (4) $2(y - z)$ ____

$9f^5g^2 \div fg =$ (1) $9fg$ (2) $9f^6g^3$ (3) $9f^4 + g$ (4) $9f^4g$ (5) $9f^4 + 9g$ ____

$1/a + 1/b =$ (1) $1/(a+b)$ (2) $1/ab$ (3) $(a+b)/ab$ (4) $2/ab$ (5) $2/(a+b)$ ____

$\sqrt{25x^{16}y^4} =$ (1) $5x^4y^2$ (2) $5x^{14}y^2$ (3) $12.5x^4y^2$ (4) $\pm 5x^8y^2$ (5) $\pm 5x^8 + y^2$ ____

The factors of $m^3 - n^3$ are (1) $(m-n)(m^2+mn+n^2)$ (2) $(m-n)(m^2-2mn+n^2)$ (3) $(m^2-n^2)(m+mn+n)$ (4) $(m-n)(m^2-mn+n^2)$ (5) $(m+n)(m^2-n^2)$ ____

The least common multiple of $a^2 - 2ab + b^2$ and $a - b$ is (1) $a^2 - b^2$ (2) $a^2 - 2ab + b^2$ (3) $a - b$ (4) $a^2 + 2ab + b^2$ (5) $a^3 - b^3$ ____

$\sqrt[3]{2}$ is called a(n) (1) surd (2) quadratic (3) integer (4) rational number (5) imaginary number ____

The Eells-Fox study illustrates the point that has been made before, namely, that what goes into an intelligence test will decide what is meant by "intelligence," and what relationships may be uncovered. The simple mathematical problems used in this "content" test are similar to the problems contained in many standard "intelligence" tests; even if they were not, we would know from correlational studies that the two sets of abilities highly overlap.

SEX DIFFERENCES AS RELATED TO TEST CONTENT

In general, for group tests made up of a mixture of items in mathematics and general science and items of a definitely linguistic character, we may expect, for the high-school ranges of talent, no appreciable differences as between boys and girls. Nor is there evidence, from the omnibus tests, of a real difference between the relative variability of school boys and girls. Even in the subtests that show reliable differences as between the sexes, frequency distributions of the scores obtained would be characterized by a large amount of overlapping.

The same statement can be made for individual mental tests, for they are similarly constituted. In the 1937 Stanford Revision, a definite, and probably successful effort, was made to eliminate tests for which either sex showed a preference; the authors of the revision did not consider it "fair" for one sex to do better than the other. Thus all study of sex differences by means of the Stanford revisions is infeasible, for the suggestion of Wellman in the *Handbook of Child Psychology* has been disregarded:[1]

> The crux of the matter, in so far as general intelligence of the sexes is concerned, is not whether one sex is better able to do particular subtests but how adequately the scale measures the whole of intelligence. The fact that a scale contains a number of subtests in which girls excel does not necessarily mean that it is overweighted with these tests; it is overweighted only if the proportion of these tests to the total is higher than it should be from the standpoint of intelligence *per se*. If the proper proportion for determining intelligence has been maintained in existing scales, then girls are slightly superior in general intelligence. If, however, the scales are overweighted with the type of subtest in which girls excel, then girls are not superior in general intelligence even though they receive higher scores. (p. 628)

Every test employed in the studies referred to above reaches a ceiling for the older or brighter boys and girls, such that real differences, if they existed along the lines of the contents of the tests, would tend to be obscured. Of the kind of differences springing from tests constructed in accordance with our definition of intelligence, we have at this time little evidence. It is not enough to know what children can do with small matters kept in memory over short periods. Hence school marks, in view of their unreliability and their tendency to be assigned in short time units on materials easily parroted, together with the infrequency of long, objective, end-of-the-year survey tests, may be considered useless as a basis for discovering genuine mental differences between the sexes.

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[1] Wellman, Beth L.: Sex Differences. [In] Murchison, Carl [editor]. *A Handbook of Child Psychology*. 2nd ed. rev. Worcester, Mass.: Clark University Press, 1933. Pp. xii, 956. (pp. 626–649.)

There may be sex differences coming in at different levels of difficulty and complexity. It is possible that when a subject is pursued to its more abstract, systematizing levels, as in chemistry, physics, or mathematics, the women lose interest; at the early fact-getting level a difference may not be apparent. Also an abstract science may be so broken down into fragments and so taught as to lose its special qualities of abstraction; this would lessen any sex differences that might be related to abstractness. For example, arithmetic, as taught through the bank account, the grocery list, or the wallpaper problem, may not be mathematics at all; it may be as discrete as the building up of new vocabulary terms. Similarly for vocabulary itself: a number of terms may be added in conglomerate fashion. The test of abstractness comes in the quality of definition, in the establishing of relationships, similarities, and differences, in the arts of logic, linguistics, and philology.

Differences that are culturally determined would scarcely go down through the early high-school or elementary-school days: the vocational implications of these differences would not be too clear at those levels. For example, a woman who teaches home economics has a considerable need for chemistry, biology, and statistics, as may the graduate student in related fields; the engineer (usually a man) easily finds justification for developing his interests in English, social science, and foreign language, for he is likely to need them all. Further analysis, too, is needed of possible differentials in the later school years when education is no longer compulsory. There should be some inquiry as to what the sexes do with respect to a choice of subject matter when they are truly free to go one way or another. An enduring, well-established preference may indicate the existence of an aptitude.

There is a chance that some meaningfulness may come out of the slight but recurrent superiority for girls in the preschool years. There the individual mental tests are heavily weighted with speech, language, and motor skills that characterize a physiological machinery that develops faster in the female than in the male.

PHYSIOLOGICAL FACTORS

One of the most striking sex differences confronting teacher and psychologist is the greater tendency for boys to develop stuttering.

Since this type of speech defect can occur at almost any age, but is especially noticeable at the time of entrance to school, there could be some relationship between it and a different growth pattern for the two sexes. It is not usually held that boys are more sensitive than girls to demands in speech or scholarship, or that they are more emotional. The pressure to speak clearly is about the same for both sexes. This pressure, however, would be relatively greater for any child or any class of children (e.g., boys) whose organic maturation was delayed.

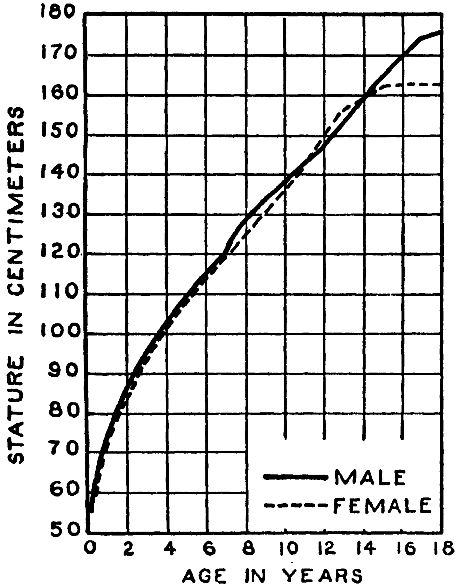

FIG. 33. Stature, Iowa City White Males, and Iowa City White Females. (From Meredith and Boynton.)

It is hazardous to project the solid evidence of a different physical and physiological time-line, as between the sexes, into the realm of behavior and mental ability. As was shown by Baldwin[1] and later by Meredith[2] and Boynton,[3] by the age of fourteen practically all the linear anthropometric measures for girls have sharply decelerated or leveled off; for boys, the same measurements are showing only a slight deceleration by the age of eighteen years. The stature curve reproduced above is combined from the Meredith and Boynton studies. It is based on a substantial number of cases for all the age ranges from three months to eighteen years, the parents of these children being above average in socioeconomic status.

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[1] Baldwin, Bird T.: The Physical Growth of Children from Birth to Maturity. *University of Iowa Studies in Child Welfare,* 1921, 1, No. 1, pp. 411.

[2] Meredith, Howard V.: The Rhythm of Physical Growth: A Study of Eighteen Anthropometric Measurements on Iowa City White Males Ranging in Age Between Birth and Eighteen Years. *University of Iowa Studies in Child Welfare,* 1935, 11, No. 3, pp. 128.

[3] Boynton, Bernice: The Physical Growth of Girls: A Study of the Rhythm of Physical Growth from Anthropometric Measurements on Girls Between Birth and Eighteen Years. *University of Iowa Studies in Child Welfare,* 1936, 12, No. 4, pp. 105.

On the basis of 6,500 roentgenograms available for 100 newborn infants, 300 children from ages one to four, 6,000 school children, and 200 college students, Flory [1] makes this observation:

> Inspection [of the roentgenograms] reveals that the five-year-old girl is fully as far along in her development as the six-year-old boy. It is significant indeed that there is a difference of one full year between the sexes in skeletal development at the average age for school entrance. By age twelve girls are as fully developed skeletally as fourteen-year-old boys. This two-year difference is maintained at ages thirteen, fourteen, and fifteen. Fifty per cent of the girls have reached skeletal maturity at age seventeen when epiphyseal closure in the hand is used as the criterion of skeletal maturity. Fifty per cent of the boys reach maturity, when judged by the same standard, at eighteen and a half, or one and a half years later than girls. . . .
>
> Growth curves for the total area of all carpal bones suggest that girls are near their maximum at age fifteen while boys approach their maximum carpal development to about the same degree at age seventeen. Growth of bones in size indicates approximately one and a half years of sex difference at age nine and two years difference at age sixteen. Girls are significantly ahead of boys in skeletal development when they enter the elementary school but they are still farther ahead when they enter high school, as long as chronological age is the major concept in school admissions and school progress. (pp. 207, 208-209.)

A suggestion to be brought forth again (in relation to the observed differential deterioration of bright children as between the sexes) may appeal to those who look within the organism for the basis of observed mental differences. According to this hypothesis, girls ought to be further along than boys at all ages up to about fourteen years — as they would be, if the tests were based primarily on memory, vocabulary, and language facility. But can there be an advantage for the girls, without a similar favoring along mathematical and scientific lines? Here the answer may lie in what happens in the early days of the child's life during which either sex that is capable of profiting by time may gain an advantage. Cultural experience is almost always offered in terms of speech — through description, observation, and visual impression. There is little tendency on the part of parents, at this point, to introduce the child to relations expressed in mathematical or scientific terms. A long-range experiment is indicated to see whether or not a heavy saturation of child life with mechanics and numerical forms would reduce the male superiority in arithmetic and related subjects during the school years. The hypothesis, however, calls for a catching up, on the part of the boys, in the late adolescent years and in the early twenties. In a sense the girls would have achieved their equality, the kind of equality now found in composite mental tests, by drawing upon a larger proportion of their total or final ability. In this way girls achieve their physical equality: at the age of twelve, they are taller and heavier, on the average, than boys, but they are not able to maintain this superiority — while they grow, girls grow faster than boys, but they stop growing sooner.

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[1] Flory, Charles D.: Sex Differences in Skeletal Development. *Child Development*, 1935, 6, 205–212.

It must be emphasized that such a hypothesis carries no weight whatever except in terms of the planning of further researches. Also, for the reasons developed in this volume, it is futile to attempt a thorough exploration of sex differences in the later ages, in terms of the contents of present-day group or individual tests. In future, having defined intelligence with a heavy saturation in the abstract, having prepared tests with high ceilings, and with full reach to complexity and originality, all in total disregard of any found or estimated differences between the sexes, we may then apply these new tools of measurement to the sex problems indicated.

SOCIAL FACTORS

It is clear that, under social and cultural conditions that tend to make women more responsible than men for the day-to-day problems that arise, divergences in the habit of abstraction are observed. This leads to the postulate that, at the higher levels of abstraction, the men characteristically go farther — more as a division of labor in the world than as a necessary concomitant of differentials in nervous tissue. The highest abstractions and constructions, whether viewed as individual accomplishments or cooperative enterprises over the years, imply a freedom from immediate personal responsibilities that is unlikely to be achieved for women in existing cultures. This assumption rests squarely upon the expectation that women as a group will continue to devote a great portion of their time and energy to rearing the young and to the maintenance of general family functions. The present tendency for women to go into all kinds of work, delegating to others many household duties, does not constitute a fundamental change, inasmuch as the new houseworkers are themselves women: what we have is a new division of labor rather than a shift as between the sexes. Similarly, the extensive employment of women in business, industry, agriculture, and transportation is carried on without a radical shift as between the sexes, in view of the smaller families in recent decades, and of the burden-lightening which comes from the extensive application of mechanical power. Increasingly it will be as feasible for women to share in all activities as it is for men to spend time with their children and to develop artistic and recreational interests. The divergence in work and play as between the sexes is, in large part, breaking down.

If, under these conditions, to be aggravated in a wartime emergency, women nevertheless prefer the satisfactions that come from their so-called traditional activities to explorations at the leaner intellectual levels, as in law, science, literature, and philosophy, we shall be thrown back upon our original premise, namely, that habit, preference, and aptitude combine to make permanent the long-observed differences between men and women.

CHAPTER XI

CONCEPTS OF FEEBLE-MINDEDNESS

It is important to clarify the meaning of *feeble-mindedness*, for the term has wide connotations in test construction and social practice.

BRITISH VIEWS

Carmichael[1] believes that "current medical teaching is overwhelmingly that reported by Tredgold, when he designates as a cause of what is termed 'primary amentia' a hereditary factor dependent upon germinal variations that have their locus in the chromosomes." (p. 109.) It is the fourth edition of Tredgold's book,[2] issued in 1922, and prevailing for fifteen years, that has so marked the thinking of medical, social, and psychological workers. Tredgold's concept of mental deficiency during this period was, as he remarked, consistent with that of the English Mental Deficiency Act of 1913.

Two English definitions follow:

Mental Deficiency Act of 1913:

Four classes of mental defectives are defined:

(*a*) Idiots. — Persons so deeply defective in mind from birth, or from an early age, as to be unable to guard themselves against common physical dangers.

(*b*) Imbeciles. — Persons in whose case there exists from birth or from an early age mental defectiveness not amounting to idiocy, yet so pronounced that they are incapable of managing themselves or their affairs, or, in the case of children, of being taught to do so.

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[1] Carmichael, Leonard: The Physiological Correlates of Intelligence. The Thirty-Ninth Yearbook of the National Society for the Study of Education. *Intelligence: Its Nature and Nurture.* Part I. *Comparative and Critical Exposition.* Bloomington, Ill.: Public School Publishing Company, 1940. Pp. xviii, 471. (pp. 93–155.)

[2] Tredgold, A. F.: *Mental Deficiency.* Baltimore, Md.: William Wood & Company 1922. Pp. xx, 569.

(*c*) Feeble-minded. — Persons in whose case there exists from birth or from an early age mental defectiveness not amounting to imbecility, yet so pronounced that they require care, supervision, and control for their own protection or for the protection of others, or, in the case of children, that they, by reason of such defectiveness, appear to be permanently incapable of receiving proper benefit from the instruction in ordinary schools.

(*d*) Moral imbeciles. — Persons who from an early age display some permanent mental defect coupled with strong vicious or criminal propensities on which punishment has had little or no deterrent effect.

Mental Deficiency Act of 1927:

> Mental defectiveness means a condition of arrested or incomplete development of mind existing before the age of eighteen years, whether arising from inherent causes or induced by disease or injury.

Tredgold defines *amentia*, as follows:

> Amentia [is] a state of restricted potentiality for, or arrest of, cerebral development, in consequence of which the person affected is incapable at maturity of so adapting himself to his environment or to the requirements of the community as to maintain existence independently of supervision or external support. (1922.)
>
> Amentia [is] a state of incomplete mental development of such a kind and degree that the individual is incapable of adapting himself to the normal environment of his fellows in such a way as to maintain existence independently of supervision, control, or external support. (1937.)[1]

Functional categories similar to those listed above were described by a Committee of the British Board of Education and Board of Control. It recognized that the divisions would overlap, but for practical purposes distinguished three classes among the "mentally incapable": (1) persons whose minds failed to develop normally; (2) persons who showed a normality of development but suffered from a disorder of mental function; and (3) persons who once showed normal development, but later suffered deterioration. These categories may be thought of respectively as cases of ***arrestation***, ***abnormality***, and ***deterioration***. They are not neatly separated from each other, and their effect upon the individual child or adult will vary with age and social status. The report points out that:

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[1] Tredgold, A. F.: *A Text-book of Mental Deficiency*. Baltimore, Md.: William Wood & Company, 1937. Pp. xvi, 556.

> . . . a wide range of special disabilities is suggestive of a defect of general intelligence. Educational attainments, general knowledge, practical ability, are all acquisitions in part dependent on intellectual capacity, so that failure in these directions is suggestive of the presence of mental defect, the absolute existence of which can only be determined by direct examination. . . . Our concept of mental deficiency, therefore, is that of a condition of incomplete development of mind of such degree or kind as to render the individual incapable of adjusting himself to his social environment in a reasonably efficient and harmonious manner and to necessitate external care, supervision or control. (pp. 8–10.)[1]

The Report distinguishes levels of idiocy, imbecility, and feeble-mindedness consistently with the British Mental Deficiency Acts. In these terms and on the basis of a wide sampling, the Committee estimated that the mean incidence of mental deficiency in England and Wales was about 8 per 1,000, and a little higher than this if we include all school pupils showing scholastic retardation.

In spite of difficulties in making the comparison, the Committee felt that there had been some increase in the incidence of mental deficiency in the twenty years since the report of the rural commission; the new disparity between incidence in rural areas (10.5 per 1,000) and urban areas (6.7 per 1,000) was greater than before. The Report goes on:

> The possibility that the higher incidence of mental defect found in the rural areas was due to the lower cultural level of the rural stock brings us to the last of the more general features of our investigation to which we wish to call attention, namely, the distribution of higher grade defectives in the various areas. Lower grade defectives were found indiscriminately in all types of district and in all classes of family and there is no reason to think that the incidence of idiocy or imbecility is distributed in any way unevenly among the different social strata of the population. But in the case of feeble-mindedness (British definition) there were great differences of incidence in different schools and villages and in different parts of the same town. The town schools which contained the largest proportion of feeble-minded children were generally situated in the slum areas, and in the villages with the largest number of adult defectives there were generally found to be correspondingly large numbers of feeble-minded children. (p. 82.)

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[1] British Board of Education and Board of Control: *Report of the Mental Deficiency Committee.* London: H. M. Stationery Office, 1929. Pp. xi, 239.

The relation between slum conditions and mental deficiency was not simple, for feeble-mindedness, that is, the highest of the subnormal levels, tended to run in families which were characterized by low mental and physical levels. Slum clearance in itself was not enough: the removal of a population to well-designed houses and better hygienic conditions did not, in the districts studied, lead to a lower percentage of mental defect. Thus the Committee was brought around to the old question as to whether or not a defective mental equipment produced the bad social conditions or vice versa — or, more realistically, to a consideration of the nature of a reciprocal relation. The Committee pointed out that the incidence of lower-grade defect in boys was 30 per cent in excess of girls; in men, 33 per cent in excess of women. For this there seems to be no satisfactory explanation. Perhaps the answer could have been found in differentials of scholastic adjustment and occupational success for the two sexes. In any case, the percentages of incidence are only rough estimates; except for the lowest grades of mental deficiency that involve an all-round organic deficiency, they are so closely tied in with shifting educational and social standards as to be practically meaningless.

Rather subtly, over the years, the British have reduced the emphasis on organic conditions or on the ascription of mental deficiency to any one set of causes. But there is not yet in the definitions of either the British Act or Tredgold an explicit recognition of the power of environmental factors (other than disease or injury) to push children into subnormal mental categories. The legal, clinical, and institutional progress resulting from the British clarification of the problem of mental deficiency sprang not so much from new scientific data on the causes or conditions of feeble-mindedness as from practical reforms that could be undertaken.

A Source of Confusion

It may be that Tredgold himself has unwittingly confused students of the question by his special view of the meaning of inheritance:

> . . . there is now an overwhelming body of evidence from those qualified by experience to express an opinion on this matter, to the effect that in the great majority of cases of amentia the condition is due to innate or germinal causes, and that it is transmissible. This was the finding of the Royal Commission.

> The exceedingly interesting and important question now arises, What is the nature of this germinal impairment? In a certain proportion of cases the mental defect of the individual has been preceded by a similar defect in his ancestors, and it may then be regarded as a definite instance of "heredity" in the strict meaning of the word. But this is by no means always the case; indeed, it is not even the rule, and in my experience it is commoner for the ancestors of defectives to suffer from such conditions as insanity, epilepsy, dementia, and allied psychopathological states, than it is for them to be actually mentally deficient. It is obvious that the repeated occurrence of such conditions as these in a family, the members of which live in an environment which does not differ essentially from that of the mentally normal, must be indicative of some abnormality of the germ plasm; in other words, of a germinal variation. (pp. 24-25.)[1]

The quotation above may be regarded as one of the most remarkable in the literature on mental deficiency. Since the "inheritance" referred to runs from insanity or epilepsy in the parent to subnormality in the child, we wonder what is to happen in the succeeding generations: Can mental defect ever establish itself in a true line of inheritance down through the generations, without benefit of the organic and social pathologies listed above? Some psychologists have missed completely the implication of Tredgold's pronouncement, for they have assumed a straight line inheritance of similar mental deficiencies (although compelled to vary from this point of view with respect to the lower grades of deficiency in which sterility prevails).

In another connection, Tredgold has expressed an opinion as to incurability which is consistent with the British definition, although not emphasized in the latter, appearing as a matter of fact only in the use of the word "permanently" in the highest grade of deficiencies which the Act designates as feeble-minded:

> Now the essence of mental defect is that it is incurable; when, therefore, it is found that defectives attending special schools are returned "cured" to the ordinary schools, it is clear that very few, if any, of them were really defectives according to the Mental Deficiency Act. My inquiries showed that in various towns in England the proportion so returned as cured varied from 2 to as much as 20 per cent., while Dr. Eichholz, H. M. Inspector of

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[1] Tredgold, A. F.: *Mental Deficiency*. Baltimore, Md.: William Wood & Company, 1922. Pp. xx, 569.

> Special Schools, in giving his evidence before the Royal Commission, stated that according to his observations from 40 to 50 per cent. of the cases classed as feeble-minded recovered under care and training. (p. 180.)

It is clear from Tredgold's statement that the concept of an *inconstant* intelligence quotient (or its equivalent in the measurement and observation of behavior) is nothing new in the medical and psychological world. Unfortunately the earlier workers tended to discount the implications of their own findings, resorting to the makeshift of "pseudo-feeble-mindedness." It is more realistic, along both theoretical and practical lines, to accumulate all possible evidence regarding the mental status of an individual, making the best possible diagnosis and recommendation; if then a child or an adult shifts his mental status (again in terms of the best measures and observations available), equal validity should be accorded both ratings. All expectations, diagnoses, and discussions will be completely circular unless this confusion can be cleared up. We know that in the higher ranks of mental deficiency (for which the British use the term *feeble-minded*, but which in American terminology may range from the low moron to the slow learner) the shifting that occurs in intelligence will drop some persons into lower classifications and raise others to levels within the range of normality. *To regard all change in mental status as an artifact is to shut one's eyes to the most significant and dramatic phenomenon in human growth.*

RELATION TO THE IQ

In this country the mental age or intelligence quotient from Binet testing has been geared to a concept of feeble-mindedness, with the thought that a mental rating would refine the general diagnosis of feeble-mindedness. Inevitably the simplicity and definiteness of the mental age criterion weakened other corroborative evidence. With the exploitation of the IQ in the Stanford Revision, this measure by itself frequently became the basis for establishing a dividing line between normality and subnormality, and for stratifying various grades of deficiency. In fact Terman, on introducing the Stanford Revision in 1916, said flatly that all persons testing below 70 IQ should be considered feeble-minded — and he was tempted to include IQ's up to 75 in the same category.

The IQ alone was to take the place of medical, clinical, educational, and social estimates. (How many children and adults over the past quarter century have landed in feeble-minded institutions on the basis of a single IQ rating in the 60's, unsubstantiated by further testing or clinical corroboration and without regard to the fact that many another of like rating was able to lead a free and useful life?)

In regard to the 1937 Stanford Revision, rather than give up the injurious habit of labeling levels of mental deficiency in terms of Binet IQ, Merrill[1] resorts to a vague differentiation between *mental deficiency* on the one hand and *feeble-mindedness* on the other, as follows:

> . . .Therefore, a clinically useful as well as psychologically valid schema for classification of IQ's must seek to differentiate measurable intellectual differences from the socio-psychological-legal distinctions that are important for the clinician who is dealing with practical problems of adjustment. To that end it is important to adopt for the lower end of the intelligence distribution a terminology that will serve to designate low intelligence without implying the presence of other behavior traits that have become associated with the term *feeblemindedness*. There is some precedent for the adoption of *mental deficiency* as such a term. In conformity with such a usage, a classification for the lower limits of intelligence need not depend on additional clinical evidence for its validity. (pp. 649-650.)

Carrying out the implications of the paragraph above, Merrill then listed as "border-line defectives" persons with IQ's of 70 to 79 (on L and M forms) and as "mentally defectives," those with IQ's from 69 downward. It is not clear that mental defectives of this type would be free from the social and educational problems which characterize feeble-mindedness.

WHITE HOUSE CONFERENCE

A few years ago the Committee on Physically and Mentally Handicapped Children of Hoover's White House Conference on Child Health and Protection attempted to arrive at some agreement in the use of terms. They conceived of the *mentally deficient* ("those whose mental handicap, whether serious or slight, is at least partially evidenced by low intelligence test scores") as comprising two groups: the *feeble-minded,* who are deficient and also socially inadequate, and the *intellectually subnormal,* who are deficient but not necessarily socially inadequate. After rounding many a mulberry bush the committee agreed upon the statements that follow:[1]

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[1] Merrill, Maud A.: The Significance of IQ's on the Revised Stanford-Binet Scales. *Journal of Educational Psychology*, 1938, 29, 641–651.

> Intelligence tests should not be used as a sole means of identifying high-grade feeble-mindedness or intellectual subnormality
>
> Careful clinical methods should be used in diagnosis
>
> The use of the term *moron* to denote those persons between 60 and 85 I.Q. in whom nothing more than simple intellectual subnormality has been demonstrated should be discontinued. To take its place, *intellectual subnormal* or some term of similar implications is suggested
>
> The term *borderline* should neither denote nor connote definite feeble-mindedness as above defined, but should have the meaning of "doubtful" only
>
> Only a fraction, about $\frac{1}{13}$, of those within the 60 to 85 I.Q. range have been demonstrated to be *feeble-minded* as that term is used in the standard definitions
>
> Favorable situational conditions play some part in preventing *marked* social failure of the mentally deficient even when unfavorable constitutional criteria are present. (p. 333.)

Several years later Wallin[2] laconically remarked:

> A number of terms have continued to be used interchangeably, such as feeble-mindedness, amentia, mental defectiveness, mental deficiency, mental subnormality, and mental retardation. Furthermore, all degrees of mental subnormality from profound idiocy to a barely recognizable degree of mental reduction exist. (p. 82.)

SOME SOCIAL IMPLICATIONS

At all events, we lack a sound basis for divorcing mental deficiency from the educational and social outcomes with which it maintains a two-way relation. There is no test by which mental competence is measured independently of the various experiential contributions to it; these cannot be kept out of the frame of reference, but better tests would reveal them *in terms of the pattern of mental growth.* Whatever use society may then make of test results will depend upon its experience with the social acceptability of persons in various categories of achievement.

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[1] White House Conference on Child Health and Protection: *The Handicapped Child: Report of the Committee on Physically and Mentally Handicapped.* New York: D. Appleton-Century Company, Inc., 1933. Pp. xxv, 452.

[2] Wallin, J. E. Wallace: Atypical Children — II. Mental Defectives. [In] Monroe, Walter S. [Editor]: *Encyclopedia of Educational Research.* New York: The Macmillan Company, 1941. Pp. xxiii, 1344. (pp. 81–88.)

A society could, if so minded, penalize or incarcerate for protective purposes many persons displaying a high grade of intelligence. A dictator, for example, can afford to let only subservient talent survive. In twentieth-century America, were it not for compulsory schooling, hardly anybody would be judged mentally deficient. To earn a living is often easier than to pass school subjects, and to vote "right" is still simpler. In political matters, as in a dozen other areas of decision, feeble-minded adults can scarcely be differentiated from the rest of the population. At the upper feeble-minded levels, persons get along all right vocationally — on the whole about as well as the "intellectuals." Machine tending, which has so largely replaced the drudgery of hard labor, makes fewer demands upon brawn but not more upon brain. The high-grade defectives, numerically about nine-tenths of all the defectives, perform creditably, provided they are guaranteed a large measure of protection against a predatory intelligentsia. That is the lesson we learn from the feeble-minded institution in which many of society's activities are reproduced under conditions that reduce confusion and exploitation.

Even the mongolian imbecile, if born with a silver spoon in his mouth, will go further than other like-afflicted imbeciles — he will go as far as an imbecile can. In the company of others whose defect was once rated as no greater than his, he will increasingly stand out: the assumption is that the imbecile has some growth potentials that will develop differentially in response to environmental stimulation. Any test or battery of tests applied to a population of such imbeciles, without knowledge of the ratio of achieved ability to potential ability, will yield nothing decipherable in terms of predicting a final status for the children involved.

That the man-in-the-street, who is judged normal or above average, needs a vast amount of guidance is attested by the legislation designed to protect him against himself and other persons, that is, to set up a cooperative life somewhat in advance of his intellectual or emotional recognition of its crucial importance. The invisible walls built to shelter the meek, the poor, and the thing-minded who care little for the world of words are of the same essential character as the classic protective institutions of family, guild, lodge, labor union, nation, and church.

Humble people, shading upward into the scholastically fit, perform most of the work of the world, even in this day of machinery. They constitute numerically the producers of the greater portion of good and high talent in the next generation. The social responsibilities of average people, on the whole, are as well developed as those of the intellectually elite; they have, for example, learned how to have children, a crucial accomplishment in any species; their social betters, the mules, have learned how not to.

THE CLINICAL SUPPLEMENT

For Doll,[1] *intelligence* is a narrower term than *mentality.*

> . . . intelligence is only one phase of "mentality." What of emotion, volition, temperament, skill, motility, and the rest? When MA and IQ fail to differentiate, the psychologist may resort to the estimation of insight, foresight, resourcefulness, shrewdness, originality, transfer of learning, and other psychological evidences of normality versus deficiency. Recent evidence reaffirms that motor retardation accompanies mental retardation among the feebleminded. They are also subnormal in general alertness (not synonymous with MA), initiative, creative aptitude, sentiments and ideals. They excel in monotonous perseveration and fall short in adaptive concentration. They live by habit, learn by rote and react concretely. (p. 408.)

In Doll's statement it is refreshing to note, consistently with the point of view in this volume, the divergence between mentality and Binet mental age. Great powers and areas outside the scope of Binet testing are implied in such terms as *insight, foresight,* and *originality;* if we were to take Doll's paragraph literally, we would throw away the test and keep the clinical records. If, under any conditions, mental tests fail to delineate these landmarks of intelligence, the business of identifying an obtained IQ with a rating of mental deficiency becomes highly impractical. It is not enough to add these elements clinically in a hit-or-miss fashion. Nevertheless in the new tests of intelligence we envisage, there will be areas not tapped in a standardized fashion. They, too, will need a clinical supplement in order to refine the all-round diagnosis and to arrive at a solution of various personal, emotional, and social problems. Except at the extremes it is hard to tell much about the social competence of children. It is a concept applicable to adults, referring to such matters as personality, ethical conduct, and job efficiency. Any child who can do his schoolwork and keep from annoying those about him is likely to be judged "socially competent."

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[1] Doll, Edgar A.: The Nature of Mental Deficiency. *Psychological Review,* 1940 47, 395-415.

Doll is unwilling to accept the view that mental deficiency is just the lower part of a frequency distribution of intelligence quotients, or that it may be the lower end of a continuous line of observations of mental growth in a large population. He has difficulty in reconciling results of a semiquantitative nature with clinical observations and case histories. It is not a problem special to subnormality, intelligence, or psychology as a whole. An experienced clinician can pull out of the files mental test records associated with certain types of mental deficiency, as in mongolism, birth injury, cultural impoverishment, schizophrenia, or senile deterioration. But he would be unreliable in classifying his subjects without recourse to physical, motor, and medical data, and he would need, in addition, measures of special abilities. Is there any such thing as "merely a quantitative deviation"? Growth in a plant or animal always involves increased complexity. This is true of mental growth. Even within the restricted range of Binet testing, its slight touch of the hierarchical in mental function involves the introduction of test items at one level not previously appropriate.

Any improvement in mental testing would distinguish apexes which, considered cross-sectionally, might lead one to believe in different types of intelligence. Tasks, problems, or relationships at any level of difficulty can be generalized into a concept of mental ability only if they have, from the first, been made to conform to the demands of a complete definition; every task and every type of task must contribute to the whole. To such a test, nothing in the realm of *intelligence* could be added by clinical observations, except through an extension and intensification of the kinds of materials found in the test itself. But, as mentioned above, the observations would be valuable in furthering an understanding of the total individual in all his organic and social connections.

RIGIDITY

Rigidity, which Kounin [1,2] regards as a more fruitful concept than "concrete mindedness," tends to characterize the older individual, given an equality of mental age. He defined it in Lewinian terms as "that property of a functional boundary which prevents communication between neighboring regions," and measured it, at least roughly, by the carry-over of satiation from one simple drawing activity to another. Thus, an old feeble-minded subject, having grown tired of drawing cats was still willing to draw bugs, turtles, and rabbits in sequence, as if he were starting all over again; the young normal subjects, having become satiated with one kind of drawing, found the subsequent tasks monotonous. In addition, the young normal group would "soldier" on the task, not cutting it off sharply, while the feeble-minded subjects were likely to be all or none — they proceeded methodically and stopped abruptly. Kounin's work indicates that research of this type may throw light on scholastic and occupational abilities in various grades of feeble-mindedness for different chronological ages.

MENTAL GROWTH OF RETARDED CHILDREN

A few studies have contributed data upon the mental growth of retarded children under standard conditions and in environments that have been somewhat modified. In the Belchertown State School[3] a group of retarded girls over sixteen years of age, with a median IQ of 68, joined a reading circle in which reports were prepared on such authors as James Otis, Stewart Edward White, Dorothy Canfield, Kate Douglas Wiggin, Frances Hodgson Burnett, Edward Everett Hale, and Henry Van Dyke — a reading list that compares not unfavorably with that of run-of-mine sixteen-year-old girls anywhere. While all the girls in the institution

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[1] Kounin, J. S.: Experimental Studies of Rigidity. I. The Measurement of Rigidity in Normal and Feeble-minded Persons. *Character and Personality*, 1941, 9, 251–272.

[2] *Ibid.*, II. The Explanatory Power of the Concept of Rigidity as Applied to Feeble-Mindedness. *Character and Personality*, 1941, 9, 273–282.

[3] Otis, Margaret: Improvement of Feeble-Minded Girls over 16 Years of Age. *Journal of Applied Psychology*, 1929, 13, 301–315.

tended to gain somewhat in IQ, the ones who participated actively in this club made the most gains, and the improvement showed up in the vocabulary and language portions of the Stanford Revision.

However, studies of this type are fragmentary. They need the reenforcement of sampling and evidence that will come when institutions, as a whole, study the progress of their inmates before and after radical cultural changes or compare the mental growth of children in various types of institutions. Within any single institution, the intensive study of a small group, without comparative data on a matched control group, is somewhat hazardous.

Occasionally there are conspicuous examples of departures from the dire outcomes for children reported as subnormal in their early years. An example of this is contained in a study by Fairbank[1] of a substantial group of children in Locust Point, a community which had originally been surveyed under the auspices of Adolf Meyer and C. Macfie Campbell in 1914. In 1919 this backward community was fortunate in securing a new type of school that acted as a genuine educational and social center for the community. Seventeen years later it was possible to locate and visit 122 of the 166 subnormal children who had been reported by Campbell. While these children showed substantial school retardation and a good deal of contact with a juvenile court or social welfare agency, their economic situation was out of line with predictions (it had been thought at the time of the first survey that self-support was impossible for 22 very retarded children and a "dubious probability for the remaining 144"):

> When three-fourths of a group of 122 subnormal individuals are found to be self-supporting, even in a period of persistent financial depression, it is evident that our earlier ideas of economic dependency among the mentally subnormal must be revised, at least to the extent of realizing that a favorable environment has its influence. Forty-seven of the men are self-supporting, and in 11 other cases the wife contributes to the family budget, making a total of 58 economically independent men. Two single women and one divorced support themselves; 29 women are supported by their husbands, and five others are also working to increase the income, a total of 37 women not dependent on social aid. This makes 95 out of 122

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[1] Fairbank, Ruth E.: The Subnormal Child — Seventeen Years After. *Mental Hygiene*, N. Y., 1933, 17, 177–208.

> cases that are financially independent. Four other men and the husbands of two women only partially support themselves, largely because of present business conditions. Five men have never had a steady job. Two women are supported by widows' pensions; another is in a state hospital; and a fourth is under social-service care.
>
> In the matter of thrift, 17 men and 20 women own or are buying their homes and 15 other men and four women are saving money. In a number of the less comfortable homes one also finds signs of thrift, such as good furniture, a radio, a piano, or an automobile, evidences of more prosperous days. One inevitably finds some poverty-stricken homes, but the majority are fairly comfortable. (pp. 183–184.)

Of interest is the record of 173 children of the subnormal cases in the original survey. Seventy-nine were of school age and sixty-four were available for examination by the Stanford Revision. To quote Fairbank:

> As one might expect to find an overwhelming majority of feebleminded offspring, I shall begin with the lowest mental group, the defective or feebleminded. Of these we found only three, with intelligence quotients averaging 66. The second group, of 24 children, test as retarded, with a base line at least a year below their age and an average I.Q. of 89. The third group consists of seven children, who, according to the Binet-Simon test and their placement in school, seem to be average normals with a normal base line and an average I.Q. of 109. The fourth group, of four children, have superior intelligence, with an I.Q. showing an average of 118. (p. 193.)

Baller[1] presents a follow-up study of a group of adults who, in elementary school, had been classified as mentally deficient through Binet testing and clinical observation. There were 206 adults meeting this criterion who were over twenty-one years of age. Of these, it was possible to locate 95 per cent. A control group of average and above average adults of the same sex, nationality, and approximate age was also analyzed. It was found that 7 per cent of the subnormal subjects had died, and only 1 per cent of the control subjects; and further that 7 per cent of the subnormals were now in institutions for the feeble-minded and none of the control subjects. Only one of the 196 subnormals and one of the control subjects were in hospitals for the insane.

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[1] Baller, Warren Robert: A Study of the Present Social Status of a Group of Adults, Who, When They Were in Elementary Schools, Were Classified as Mentally Deficient. *Genetic Psychology Monographs*, 1936, 18, No. 3, 165–244.

In educational achievement, it was found that the retarded group had petered out at high school, a large number having been placed in "opportunity rooms." In the control group, the number going to college was substantial, the men showing a much higher incidence in this respect than the women. Contrary to the usual statistics, the differential fecundity between the two groups was not marked; there were 111 children born to the feeble-minded and 93 to the control group, the average number of children for the married among the former being 1.3 and for the latter, .8. (Since the average age of the subjects was around twenty-seven years at the time of the study, further childbearing can change these percentages.) While the subnormals showed a much worse police-court record than the controls, and they were occupationally a more unstable and dependent group, Baller points out that their own home backgrounds were less stable, they had difficulty in securing employment, and they were often residing in the worst sections of the town. Nevertheless 83 per cent of these subnormals have been to some extent self-supporting. During the depression of the 1930's both groups had difficulties: 42 per cent of the feeble-minded went on relief, and 16 per cent of the control subjects; that is to say, through an ironic twist of individual and social factors, a substantial number of the average and above average adults did not compare favorably with the upper 60 per cent of the mentally deficient.

It is seen that Baller's results fall somewhere between fatalistic accounts of the bad effects of child subnormality upon subsequent social adjustment and the Fairbank results referred to above. In Baller's study there is no evidence of special guidance or community assistance in behalf of this subnormal group, with the exception of the probable helpfulness of the school opportunity rooms. What could be accomplished in a total preparation of the individual and of society for the scholastically subnormal, with a strong encouragement of special aptitudes, as in crafts and skilled services, is a chapter for the future.

Phillips[1] conducted an intensive investigation of 365 pupils (203 girls and 162 boys) who were in attendance in a special residential school from 1929 to 1938 and who were selected for this study because of scholastic retardation. All testing was done by the author, utilizing an Australian revision of the Binet scale which had been standardized on a sampling of 3,346 school children. The IQ range on admission was from 50 to 75, with a few cases slightly below or above these limits. All the children were enrolled before their twelfth birthday and were regarded as appropriate candidates for the special school. Phillips found that these subnormal children tended to remain low in intelligence quotient: "A small number of cases show a continuous increase over the period of the investigation, a large number show a continuous decrease, a still larger number exhibit neither increase nor decrease, while a few seem to fluctuate." He found a decline in IQ with repeated applications of the Australian Binet test that was proportional to the interval between testings. Subjects whose IQ's were low declined faster than those with a relatively high IQ. After a six-year interval, the correlation between test and retest was $r = .71$. A further conclusion may be cited:

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[1] Phillips, Gilbert E.: *The Constancy of the Intelligence Quotient in Subnormal Children.* Australian Council for Educational Research, 1940, Educational Research Series No. 60, pp. 86.

> Environment has an appreciable influence on the I.Q. This is exhibited in comparing the I.Q.'s from two testings between which an environmental change has taken place. The change from inferior to relatively superior environment results in a retardation of the decrease in test scores. (p. 77.)

PHYSIOLOGICAL FACTORS

Penrose[1] has stated recently:

> Adverse factors in the environment, which operate at any time after a child is born, are responsible for mental impairment in a certain number of cases. Some of these environmental factors are more often operative in the high-grade and others in the low-grade group. They must be appreciated before the hereditary factors can be intelligently discussed. If injury or disease affects the brain of an infant so that its subsequent development is impaired, defect may result but, in the opinion of most observers, no great proportion of the total number of cases of mental defect can be attributed to such accidents. A few cases of defect, usually severe, and associated with paralysis of one side or other of the body, are undoubtedly due to injury at birth. It is, however, incorrect to assume that injury at birth is a major factor in the production of mental deficiency.

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[1] Penrose, L. S.: Inheritance of Mental Defect. *Scientific Monthly*, N. Y., 1941, 52, 359–364.

> On the other hand, there is evidence that in the period before birth environment is by no means constant for every child, though detailed knowledge of the means whereby intra-uterine influences affect mental development is limited. . . . It has been estimated that from 1 to 5 per cent. of institutional cases of mental defect are, at least partly, due to congenital lues. (p. 360.)

Penrose points out that another set of prenatal environmental factors leads to the appearance of mongolism, a deformity that may bear a positive relationship to the age of the mother at pregnancy. In cases of severe mental defect in the child, the parents and siblings are usually normal. Penrose estimates that the likelihood of a second idiot or imbecile being born to normal parents is less than 3 per cent. In summing up, he says:

> On the whole, sex-linked inheritance seems to play a comparatively small part in determining intellectual subnormality. Sufficient has been said to show that the hereditary background of the low-grade cases is complex and varied. Recessive factors play an important part, but the hypothesis, favored by Goddard in his pioneer work on this subject, that all heritable mental defect is a single recessive trait, is untenable. (p. 363.)

Doll[1] estimates that from 6 to 10 per cent of all the mentally deficient persons at Vineland have motor handicaps as a result of cerebral birth injury. Since he believes that not over one-fifth of 1 per cent of the general population are birth injured, the figure for birth injury among the feeble-minded is thirty times that among normal persons. He estimates that, while 40 per cent of all birth-injured children of school age are subnormal, the range of intelligence among the injured runs from idiocy to the superior adult level. Considerations outlined in Part I of this volume show how hard it is to undertake the cerebral localization of injury in relation to behavioral handicap. In view of the fact that many workers in educational circles hold that subnormality of intelligence is coexistent with physical and motor deficiencies, and is particularly resistant to improvement, Doll's conclusions based on twelve birth-injured cases (studied by Doll, Phelps, and Melcher) is of special interest.

> Thus all but one of twelve cases studied for fairly long periods of time showed unusual mental growth not characteristic of the ordi-

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[1] Doll, Edgar A.: Psychological Significance of Cerebral Birth Lesions. *American Journal of Psychology*, 1933, 45, 444-452.

> nary feeble-minded. Individual cases are especially impressive. Thus, one child with a Binet mental age of 4 at life-age 8 (I.Q. 50), gained four years in mental age during the next four years, a rate of growth which was twice the I.Q. prediction. Another child, with a Binet mental age of 6 at life-age 12 (I.Q. 50), made four years' mental growth in the next four years. A third case, with I.Q. 100 at life-age 5, made no appreciable mental development during the next three years, but during the following five years increased five years in mental age.
>
> These particular growth records are independent of the difficulties of mental examination and there is no evidence that anything unusual occurred in the treatment or training. Instances of remarkable functional improvement late in life apparently capitalizing a continuing maturation of intelligence not previously expressed in behavior are not unusual. (p. 448.)

In general, the results at Vineland indicate that the mental development of the birth-injured continues longer than that of other feeble-minded subjects.

Thus, Doll is consistent with workers in the California Institute of Child Welfare who have postulated not only factors strictly environmental and hereditary as contributory to an inconstant IQ, but constitutional factors arising out of organic happenings that are uniquely determined within the organism's structuring and maturing. Such changes are predictable neither from genealogical tables nor from educational events. Perhaps they can only be resolved by a new type of scientist devoting himself, at once, to neural biochemistry and psychosomatics. The psychologist, establishing the evidence for radical physical, motor, and mental changes, is in need of chemical and anatomical assistance.

A few attempts have been made to bridge the gap between organic defects in nervous tissue and coexisting mental deficiency. They should not be regarded as more than suggestive. Inevitably there is a tendency on the part of both physicians and psychologists causally to associate conditions whose true interrelationship, if it exists, is not on the main line of events. Lombroso's error in connecting physical stigmata with social waywardness is a case in point, and it is an ever-present pitfall. As Krogman[1] says in a review of two recent books by E. A. Hooton:

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[1] Krogman, W. M.: Are We Coming or Going? *Scientific Monthly*, N. Y., 1941, 52, 274.

> The statement that criminal behavior is associated with a given physical type ("mosaic" of morphological traits) pays too little attention to the social aspect of the definition of what constitutes a crime. During Prohibition it was a crime to possess liquor; now it is not. Yet many of us, no different physically now than then, were "criminals" every time we partook of some liquor "just off the boat"! Man defines the crime, not crime the man, and criminal opportunity bulks at least as large as the criminal's physique. We are products of time, yes, but time may be measured in the social set-up of the moment. (p. 274.)

The inferiority commonly found in the physique of mentally deficient children may be, except at the lowest grade, a reflection of the economic or cultural status of their parents. Retarded children are probably the last ones to profit by the discoveries and recommendations of the nutritionist. A need for vitamins, minerals, or medical care will be last recognized in the families of these children and remediable organic conditions may go from bad to worse. This particular correlation, like so many others, is, in part, a derivative of a further set of causes shared by the two sets of variables. It does not operate against the further principle that the impairment of cerebral tissue, through any cause whatever, will set limits to mental growth. A sadistically minded society, bent on keeping the lowly and the unwanted pressed down, would prescribe both physical and cultural malnutrition.

Jervis,[1] among others, has noted phenyl pyruvic acid in the urine of the mentally deficient. He states that it has never been found in the urine of normal persons. Apparently it is a temporary product, quickly oxidized under normal metabolic conditions. Jervis also associates certain types of idiocy with a faulty metabolism of lipoids. Here the symptoms include visual deterioration as well as a general pathology of the nervous system. Truly we have, in the prospect of nerve cells being saturated by inert, fatty tissue, weird support for the old expression "fathead!" A third type of pathology mentioned by Jervis consists of a degeneration of the basal ganglia, resulting in certain motor disturbances and a degree of mental deficiency. All these diseased conditions of the organism are types of failure in metabolism. Jervis holds that the defective mechanism may be genetic in character.

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[1] Jervis, George A.: Inherited Biochemical Alterations in Certain Types of Mental Deficiency. *Proceedings of the American Association for Mental Deficiency*, 1937, 42, No. 2, 101–115.

Bixby,[1] on the basis of an analysis of the condition of twenty-five mongoloid mental defectives, is impressed with the close organic resemblance of these cases to normal body chemistry. She thinks that pituitary malfunctioning comes closest to explaining the conditions found, and that a high level of blood cholesterol in the mother may damage the fetus.

Himwich *et al.*[2] stress the importance of a proper amount of blood sugar and oxygen, if the brain is to function normally. (The depressing and dislocating mental effect of oxygen deprivation in high altitudes is well established.) They regard sugar as the foodstuff of the brain, and fat as a contributor to its structure, holding that the vitamin B complex is essential if the brain is normally to oxidize carbohydrates; thus in mongolism "the lowered metabolism is due to a failure of cerebral enzymatic systems."

Mongolism

After pointing out the anomalies found in the structure, proportions, and positions of the brain parts in mongolism, in a study based on eighteen mongoloid brains and ten spinal cords, Benda[3] declares that the deficiencies found are not congenital, but a product of pressure upon the brain, a condition which is aggravated up through the early years of childhood. He states further:

> The study of the central nervous system in mongolism indicates the presence of extrinsic factors which act upon the brain. I may go further and state that the edema and the strict dependency of the alterations upon the vascular system indicate that the noxious agent is to be sought within the blood stream.
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> It is not within the province of this paper to go into details on the etiology of the altered blood metabolism. I may, however, say that of the four factors which have to be considered: vascular

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[1] Bixby, Emily May: Further Biochemical Studies in Mongolism. *American Journal of Mental Deficiency*, 1940, 45, 201–206.

[2] Himwich, H. E., Fazekas, J. F., and Nesin, Sarah: Brain Metabolism in Mongolian Idiocy and Phenyl Pyruvic Oligophrenia. *American Journal of Mental Deficiency*, 1940, 45, 37–41.

[3] Benda, Clemens E.: The Central Nervous System in Mongolism. *American Journal of Mental Deficiency*, 1940, 45, 42–47.

> diseases, anemias, avitaminoses and hormonal deficiencies, there is not sufficient evidence for any one of the first three, but evidence that a hormonal deficiency is a causative factor in the production of the physical symptoms in mongolism has accumulated through various clinical and pathological observations. They point toward a deficiency of the pituitary gland. The character of the lesions in the brain is compatible with such an etiology. Whether the deficiency is due to a primary disorder of the gland or to inefficiency of its action through interference by noxious metabolic factors, is a question at present under investigation. (pp. 46–47.)

Some preliminary work by Kreezer[1] at Vineland indicates a possible association of the degree of mental defect in mongolism with irregularities in the electroencephalogram. He cites as probable factors joining the characteristics of brain waves to neural anatomy, the condition of individual nerve cells, the degree of cell synchronization, and the effects of different amounts of cerebral spinal fluid about the brain. But, as Kreezer and Smith[2] point out, there are wide individual differences in the regularity of alpha brain waves at all levels of ability, and these would tend to mask any noticeable progressions in small samplings.

Cretinism

Gesell, Amatruda, and Culotta,[3] in a study of six cretinous girls, reported at the beginning of treatment for hypothyroidism a developmental quotient (the ratio of behavior age to chronological age) ranging from 10 to 85 points below the normal average of 100. After treatment, lasting from one year to ten years, there were improvements in the mental status of all the children, in one case amounting to 65 points. Four of the six children were thought to have been brought up from the defective to the normal level, all having been regarded as defective when first observed. The authors conclude:

> The final influence on the cretin is therefore contingent not so much on the age of the child or his maturity status at the time of

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[1] Kreezer, George: Electrical Phenomena of the Brain Among the Feeble-minded. *Proceedings of the American Association for Mental Deficiency*, 1937, 42, No. 2, 130–141.

[2] Kreezer, George, and Smith, Franklin W.: Brain Potentials in the Hereditary Type of Mental Deficiency. *Psychological Bulletin*, 1937, 34, 535–536.

[3] Gesell, Arnold, Amatruda, Catherine Strunk, and Culotta, Charles S.: Effect of Thyroid Therapy on the Mental and Physical Growth of Cretinous Infants. *American Journal of Diseases of Children*, 1936, 52, 1117–1138.

> diagnosis as on the residual physiologic capacity and the latent growth potency of his neuro-endocrine system. Thyroid therapy cannot bring about normality if there has been a fundamental impairment of that system, hereditary or developmental. The initial response to treatment is part of a total symptomatology, and at the same time is an index of the reserve capacity of the neuro-endocrine system. (p. 1138.)

Workers with cretins commonly report considerable physical and physiological improvement with the administration of thyroid extract. Improvement in mental development appears to be a less sure outcome and to depend upon numerous factors.

LOOKING FORWARD

The position taken by A. Myerson[1] in a report for the Committee on Psychiatric Investigations of the National Research Council (Madison Bentley, Chairman) may serve to clarify the present status of science and sociology in regard to the feeble-minded:

> The study of feeble-mindedness has suffered from the over-emphasis laid upon certain exceptional sociological situations, namely, the occurrence of so-called families who really represented ecological groups and who have come down in history as the great paradigms of the sociological and biological threat and danger to the race by the feeble-minded. The Nams, the Kallikaks, the Tribes of Ishmael, the Virginians, and others of the royal families of the feeble-minded became the basis of generalizations which were, as a matter of fact, based on flimsy evidence, on what may really be called statisticalized gossip. . . .
>
> It may be stated that in those groups of the feeble-minded concerning which we have some definite knowledge, heredity does not appear to be a factor of any real importance; that in those groups where we have little real understanding, and where the appearance of the individual corresponds more to that of the so-called normal, heredity appears to be of great importance. It may safely be stated that there is some correspondence, on the whole, between diffuse bodily defect and inferiority, on the one hand, and mental inferiority, on the other. It also appears quite certain that we are not yet at the point in understanding where we can speak of feeble-mindedness as anything like a biological unit for which we may expect Mendelian ratios. (pp. 36–37.)

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[1] Myerson, A.: Medical Psychiatry. [In] National Research Council Committee on Psychiatric Investigations: *The Problem of Mental Disorder*. New York: McGraw-Hill Book Company, Inc., 1934. Pp. x, 388. (pp. 28–38.)

In the 1940's, the world is busy and too frightened to tolerate avalanches of "statisticalized gossip." We should abandon what neither biological nor social science has been able to establish: long family lines and class lines of mental deficiency that were thought to appear with the divine regularity of Mendel's wrinkled garden peas. There is work and a place for everyone except the vicious. The persons most to be feared are not the feeble-minded, but men of high intellect pledged to destroy the essence of morality and democracy.

CHAPTER XII

CONCEPTS OF GENIUS

Mental ability is judged by the attributes listed in a definition of intelligence; the highest rank in mentality is assigned to persons who perform best on the measures by which the definition is implemented. This leaves room for disparity as between the highest ability and a concept of genius.

THE PLACE OF GENIUS

The term *genius* may involve the extraordinary development and employment of test aptitudes weighted in the direction of originality, or it may signify other attributes. An extreme love for humanity can be combined with an ordinary ability to master difficult and complex affairs. There are turning points in history when a supreme example carried to the point of martyrdom will raise a man to the rank of social genius, within his era or thereafter. Sympathy, courage, vitality, character, and appreciation of the beautiful, on occasion, hold a high place in the furtherance of human aspirations; under the right circumstances they lead to a cultural contribution surpassing purely intellectual achievements. The glory of the race lies in its great minds and in its great hearts.

Do the attributes of intelligence allow scope for the genius concept? Could a Freud have made his contribution, which is generally considered of the genius order, without proving his ability to master difficult and complex abstractions — all impregnated with genuine social values? Is talent at the genius level a flowering of the higher forms of these attributes, or is it something distinct and perhaps unique? Over the years the literary attitude has inclined toward the latter view: genius cannot be measured, analyzed, or predicted. The psychologist is more hopeful.

Frequently the genius-intellect transforms the old axiom; he puts all his baskets in one egg. He piles up data, observations, and insights given piecemeal to others, placing them in an incubator for hatching out. The egg must be carefully tended and it must be a true egg capable of enormous development. What emerges scarcely resembles the original content, for it must now be viewed on a higher level of organization or abstraction. No laws of physics, chemistry, or biology have been violated; rather they have been overlaid by laws and principles not previously demanded.

Consistently with cultural habit, we may use the word "genius" in approving, or at least recognizing, extraordinary ability in any activity. Popular speech has expanded the concept to include great achievements in color, line, sound, and mechanics. There is no need for confusion. The artistic, electrical, musical, or mechanical "wizard" is an intellectual genius in the technical sense, too, if he can pass the highest tests of intelligence; otherwise he is not. If he falls below the top abstract levels, he may be no less accomplished, no less rare, and no less needed in human lives.

The fragmentary evidence available on the childhood of great contributors to human progress leads to the supposition that, as a rule, they would have done well on intelligence tests, and that their outstanding potentialities would have been clearly revealed in measures centering in the nine attributes. Characteristically the great artist is a man of great ideas, and this can be said of the engineer, architect, musician, or humanitarian. But, at any level of creative work, strength of feeling, rightness of attitude, and a long-time devotion to ideals may polarize an organism whose abstracting powers were at first ordinary.

As the scientist increasingly applies his special methodology in evaluating laws, customs, and politics, he will recognize in the world today a shortage of complex intellects that are well-disposed. However, the kind of abstracting ability that operates within the limits of a predetermined scientific procedure is reasonably abundant. Men of less-than-genius talent, while making no unique contribution to technical problems, rarely discovering new methods, and adding only modestly to the data-heap, may nevertheless prove effective allies in showing what can be done to gear science into social progress. Their sensitivity to human needs and their acceptance of scientific habits of thought mark them for the leaders of the future. As workers who can do most to break down the deadly dichotomy between the men who know and the men who control, they may become the generators of a new genius line that will fuse, at the highest level, the forces of personal ability and collective action. This, in America, is the role of the top graduates of our better colleges — of young persons gifted in scholastic aptitude who manage to escape an early, formfreezing "success."

GENIUS AND THE IQ

Originally, the term *genius*, as applied to a child, had been taken to mean about what the man-in-the-street understands by it: the promise of extraordinary intellectual accomplishment leading to a place among the very best minds of a generation, together with the expectation that special skills or discoveries would set him apart from others. For twenty years it has been fashionable to place in this exalted category any school child who could secure an IQ of 140 or more on the Stanford-Binet scale. But as Lorge and Hollingworth[1] dryly remark, after a decade of experience with hopeful predictions:

> . . . it would appear that the term "genius" is thus misapplied, unless we wish to define as "geniuses" persons who represent approximately the best fourth of all students graduating from American colleges. . . . It is only when we have an IQ (Stanford-Binet) of at least 160 in a child, that we may begin to expect mildly noteworthy accomplishments, such as the winning of "honors" in a first class college. (p. 224.)

Lorge and Hollingworth then consider what accomplishments may be expected of children who reach intelligence quotients of 180 or above. They studied five children who, at maturity, pushed to the top of Thorndike's CAVD tests. By the age of twenty-two, "one had prosecuted research in history, one in mathematics, one in chess. Two had become established in learned professions." In short, these test-elite, the last survivors of a long screening process, have been able to do research, win prizes, play chess, and make Phi Beta Kappa! To the layman these are indeed dazzling accomplishments; to graduate students and sated professors, faced with abundant examples of precocity, these accomplishments, while creditable and truly scarce in the general population, are far below that particular flowering of capacity and achievement to be designated *genius*.

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[1] Lorge, Irving, and Hollingworth, Leta S.: Adult Status of Highly Intelligent Children. *Journal of Genetic Psychology*, 1936, 49, 215–226.

It is possible that in recent years some members of the Lorge-Hollingworth group not in the topmost rungs of the test have distinguished themselves. An unfavorable prognosis is held out for children who, conscious of their "giftedness," lean back on their laurels before intellectual accomplishments have validated their test ratings — if not before a second administration of the test has validated the first one. This not uncommon course of events has been documented by Rockwell:[1]

> One day, some years ago, I was sitting in my office when a student entered. She was a stranger, registered in another department. She seated herself, looked at me in a rather casual way, and then remarked that she was a *genius*.
>
> I had known, ever since I had read the Stanford studies on genius, that a considerable flock of them were at large. I fear I had assumed — or rather, hoped — that most of them were within the confines of California; yet here, by her own admission, was one in Minnesota. I had then, and still have, a very high respect for a high I.Q. But I also had then, and I still have, a profound contempt for the witlessness of an individual who confuses a good performance on a test with the achievement that we ordinarily associate with genius. (p. 80.)

Witty[2] sums it up:

> . . . no investigation discloses any justification for synonymous use of the terms "IQ 140 plus" and "genius." Some investigators have recently been led to believe that children testing near IQ 180 may prove to have the qualifications to justify the label "genius" or "near-genius." This hypothesis lacks adequate validation as do claims concerning the relative number of boys and of girls in the highest IQ categories, the distribution of IQ's in different racial and social groups, and many other popular beliefs related to "superiority." Nor does there appear to be in the original studies or in the subsequent follow-up investigations, any justification for assuming that gifted children will become the leaders or creators of the future. (p. 512.)

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[1] Rockwell, John G.: Intelligence Testing: Its Basic Assumptions and Unanswered Questions. *Educational Method*, 1939, 19, 80–92.

[2] Witty, Paul: Some Considerations in the Education of Gifted Children. *Educational Administration and Supervision*, 1940, 26, 512–521.

THE STANFORD STUDIES

While this habit of identifying IQ's of 140 or above with genius was started by Terman[1] and was displayed a decade later in the volumes devoted to "the genetic studies of genius," it was modified somewhat in 1940:[2]

> Our conclusion is that *for subjects brought up under present-day educational regimes, excess in IQ above 140 or 150 adds little to one's achievement in the early adult years.* This does not mean that potentiality for achievement is the same for IQ's of 140 and 180. We do not believe that it is. The more probable interpretation is that we have not learned how to bring the highest intellectual gifts to normal fruition or how to steer them clear of the dangers that threaten personality development in extreme superdeviates. (pp. 83-84.)

In the same volume, following the work of Lorge and Hollingworth mentioned above, Hollingworth[3] reaffirmed her belief in a contrary viewpoint:

> . . . the degree of mental ability involved in producing works of genius falls as far above 140 IQ as the latter falls above the generality. At and above 180 IQ performance begins to appear that corresponds to the lexicographer's idea of genius. (p. 62.)

Burks, Jensen, and Terman[4] attempted in 1930 a follow-up study of a thousand children. They had been screened out of a sampling of California children who, six years before, were judged gifted on the basis of an IQ of 140 or above on the Stanford Revision (abbreviated form).[5]

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[1] Terman, Lewis M.: *The Measurement of Intelligence: An Explanation of and a Complete Guide for the Use of the Stanford Revision and Extension of the Binet-Simon Intelligence Scale.* Boston, Mass.: Houghton Mifflin Company, [*c.* 1916]. Pp. xviii, 362.

[2] Terman, Lewis M., and Oden, Melita: Correlates of Adult Achievement in the California Gifted Group. The Thirty-Ninth Yearbook of the National Society for the Study of Education. *Intelligence: Its Nature and Nurture.* Part I. *Comparative and Critical Exposition.* Bloomington, Ill.: Public School Publishing Company, 1940. Pp. xviii, 471. (pp. 74-84.)

[3] Hollingworth, Leta S.: The Significance of Deviates. Review of Research. The Thirty-Ninth Yearbook of the National Society for the Study of Education. *Intelligence: Its Nature and Nurture.* Part I. *Comparative and Critical Exposition.* Bloomington, Ill.: Public School Publishing Company, 1940. Pp. xviii, 471. (pp. 43-66.)

[4] Burks, Barbara Stoddard, Jensen, Dortha Williams, and Terman, Lewis M.: *Genetic Studies of Genius:* Vol. III. *The Promise of Youth.* Stanford University, Calif.: Stanford University Press, 1930. Pp. xiv, 508.

[5] Terman, Lewis M.: *Genetic Studies of Genius:* Vol. I. *Mental and Physical Traits of a Thousand Gifted Children.* Stanford University, Calif.: Stanford University Press, 1925. Pp. xv, 648.

In view of the explicit labeling of this survey as a study of *genius*, together with later tendencies to emphasize *giftedness* and finally, as shown above, to express doubt about any relation, above IQ 140, between IQ increments and adult success, it is helpful to examine the method of selecting the original gifted group. The following steps are outlined in Terman's first volume:

(1) A sifting procedure by questionnaires sent to teachers in grades 3 to 8. The teacher was asked to name from one to three of the most *intelligent* pupils in her room. One child could be included "of moderate general ability" — if he showed unusual special talent, as in music, drawing, or mechanical ingenuity. From these reports the examiners selected the children to be tested, allowing the proportion in a particular school to run from 20 per cent (for the "best" schools) to 2 per cent (for the "poorest" schools).

(2) Administration of the National Intelligence Test, Scale B (a group test, Army Alpha in type). A percentile score of 90, or occasionally of 80, qualified the pupil for further testing. These normative percentiles were based on the school population of a small California city.

(3) The qualified children next were given an abbreviated version of the Stanford Revision. For children whose parents were native-born the scale included thirty-seven items, with the vocabulary test appearing six times; for children of the foreign-born, forty-four items, with no test of vocabulary. Both versions "took account of diagnostic value, variety, brevity, and ease of administration." Children seven years of age or older, of native-born parentage, *were frequently rejected on their showing in the vocabulary test alone.*

(4) Most of the children exceeding IQ 125, as indicated in step 3, were retained for measurement by the complete scale. The final group included children reaching IQ 140 below age eleven, lower quotients being accepted for the later chronological years (IQ 132 at age thirteen and a half to fourteen).

(5) In grades 1 and 2, some of the steps were omitted, many cases being secured by testing the siblings of qualified older children.

In this way, it was thought that perhaps 75 to 90 per cent of all the children in the elementary schools of the sample, who could have reached IQ 140 on the full Stanford-Binet, found a place in the main group of 643 children. The mean IQ for this group was 148. (It was corrected to 151, for test deficiencies at the higher levels.) The average IQ was the same for each sex, but the boys outnumbered the girls, 352 to 291 — a ratio of 121 to 100.

A method of selection in which teachers choose children will lead to halo effects with respect to school progress, trustworthiness, and socioeconomic status. The data indicate that these children, at the time of the survey and two years later, did indeed excel in such characteristics, although there is a tendency to ascribe the superiority to the mere fact of having obtained a high Stanford-Binet rating.

In the follow-up study by Burks, Jensen, and Terman,[1] after an interval of approximately six years, it was found possible to include only the younger children, and it was necessary to correct the IQ's for the lack of "top" in the Stanford Revision. Hence only 54 cases of the original 643 were available for IQ comparisons — 27 boys and 27 girls. For the boys, the 1921 mean IQ was 147 and the 1927 mean, 144 — an insignificant difference; for the girls the change over the six-year period was from 150 to 133, a loss of 17 points. While it is unlikely that the 54 cases available are representative of the original group, there is no reason for expecting a noticeable difference as between girls and boys. There is a suggestion, therefore, that the girls are unable to maintain the high IQ's reached in the first testing.

We may turn the matter around and wonder if many of the girls (or boys) should ever have been placed in mental categories under the designation "gifted." Analogously, the complicated screening procedure mentioned above would eliminate a child whose mental growth was being accelerated, but who at an early age had not developed his full scholastic aptitudes. Any *predictions* of later IQ status on the basis of the first testing would have been hazardous: the correlation between first and second testing was probably not above $r = .60$, and twenty-four cases out of fifty-three showed a change in IQ of 15 points or more (all changes for the girls being downward). No theoretical formulation is necessary to account for the changes found: they are inherent in Binet testing, and they probably reflect, although unreliably, real changes in scholastic ability. If the tests had been suitably extended upward, it is likely that more radical changes would have been recorded. (Some recent materials of Witty's[1] indicate that sex differences may not be found if a large sampling is available. On the basis of a compilation of over 27,000 tests, chiefly the Terman Group Test and the Otis Self-Administering Test given to high-school pupils, he was unable to find any reliable differences in central tendency or variability as between the sexes. In this group the ratio of boys to girls for the brighter children was as follows: IQ 140 and above, .94; IQ 130 to 139, .98; IQ 120 to 129, 1.07; IQ 110 to 119, .97. Witty could not guarantee that his sampling was entirely representative.)

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[1] *Op. cit.*

In Volume III, *The Promise of Youth*, as in the first volume, the general social and scholastic status of the group was reported as superior. The list undoubtedly contains a few persons who are in line for genuine distinction. For the majority, however, the picture is one of disappointment. There is as yet no evidence that California is marked for the recrudescence of an intellectual and artistic spirit, consistent with the verbal talent displayed by these pupils. For example, the eleven girls who showed extraordinary literary ability have not been heard from. While a few may accomplish something unusual, it is likely that any later distinction will have only the mildest relationship to anything discoverable in Binet testing or in early school compositions. In schoolwork one of the hardest things to control is the amount of parental assistance; with parents heavily weighted toward the higher economic and cultural levels, we may expect English themes that are somewhat out of line with the mental ability of the child himself.

All these factors of personal and social relationships, together with the meagerness of the evidence along strictly intellectual lines, permit us, following Rockwell's suggestion, charitably to remove from the California "gifted," the gilded medal of self-conscious superiority. The boys and girls described in the two surveys may be regarded as typical of the better college students, or of the C-student in our most highly selective colleges.

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[1] Witty, Paul A.: The Relative Frequency of Gifted Boys and Girls in the Secondary School. *Educational Administration and Supervision*, 1934, 20, 606–612.

The hardest test items to which any of these "geniuses" was subjected were those for "superior adults" in the 1916 Stanford Revision. They consisted of the following: a short vocabulary test (for which a passing score predicated a total vocabulary of only 13,500 words); a test of visualization in which the subject guessed where holes would appear when paper was folded and cut in certain ways (a game familiar to generations of American school children); the repeating of eight digits that have been slowly spoken by the examiner, and the repeating of seven digits in reverse order; giving the sense of a passage not unlike a text in elementary ethics; and finally, a little numerical conundrum, beloved of many a junior-high-school pupil, centering in the problem of how to measure 7 pints of water in a 3- and a 5-pint vessel (a hint is given to the subject: you fill the 5-pint vessel first). Thus we have *at the topmost rung* of a test long utilized to locate "geniuses" — only this and nothing more!

THE NEED FOR TEST IMPROVEMENT

Certainly a score based on the Stanford Revision is in a realm of discourse different from any meaningfulness that can be attached to the terms *gifted* and *genius*. Many truly gifted children will pass such items with their left hands while their minds are working elsewhere, at such an early age as to precipitate tremendous IQ's. Glib children, word-minded, test-wise, and parent-prodded will also reach the glamorous heights of test facility. Some children who are not facile enough, or sufficiently interested in school tasks, weak on general information, but otherwise engaged in the hot pursuit of fundamentally abstract and creative ideas, are lost to view in the course of a standard testing program, or, if thrown to the top of the heap, are undifferentiated from the intellectually second-rate. Many children with IQ's of 140 or above are indeed mediocre. Their abilities happen to parallel those required in simple mental tests. They are measured up to the hilt, with no indication of further mental reserves.

Everyone has long known that Binet testing offers little opportunity to show what new solutions or original patterns a child can produce. Binet tests, by definition, are restricted to the simple, the piecemeal, the common, the overlearned. An inevitable sequence of the low abstraction level of Binet materials, including all their revisions, is their permanent disqualification for the discovery, analysis, or understanding of the truly gifted. It can be stated flatly that at the present time we have little to offer our brightest children in the way of measurement, and not too much in the way of educational and social guidance.

The essential features of needed test improvements have already been sketched. We shall have to rely heavily on *originality, concentration of effort,* and *resistance to emotional forces.* The case for originality, for creative effort, for new ways of formulating and solving abstract problems is self-evident. Children of the highest talent follow, and then they lead, but the concepts of *giftedness* and *genius* refer almost exclusively to the second function.

CHARACTERISTICS OF GENIUS

A normal child with a good ear and a good memory can find his way skillfully among average and above-average thoughts in a half dozen languages. This accomplishment will be uncommon because so few children have ever been motivated or instructed in multi-lingualism. A Keats, creating language forms with which to clothe unique and beautiful thoughts, reveals the clew to genius. There is, however, a place for genius in the mastery of languages. The expert in literary criticism may approach his work at the highest level of analysis and comparison, accomplishing results equal to that of the poet, but different; we need not deny him the high rank if his work rises mountainlike above the prosaic plain.

Accomplishment at the genius level is often saturated with the quality which we have called *a concentration of energy.* In some cases minute steps mount to a pyramid of discovery and creativity. Darwin's long scientific efforts, slowly polarized in the direction of his evolutionary theories, illustrate the process. At times the application of energy at these levels is more explosive in character. The history of science is dotted with sudden discoveries of physical effects, relationships, and laws previously obscure. After the discovery, it seems clear that the explosion occurred only when combustible materials were available and powder trains, perhaps intuitive or barely conscious, had been neatly laid down.

The man of talent persists until his own mind is clear. That such clearness for himself or for others is a temporary phenomenon subject to revision, does not detract from the rareness of the energy-burst. In the early days of science, theoretical, experimental, or descriptive, the opportunities were such that a man making one discovery was likely to make many others, frequently over a wide territory. As scientific branches mature and display an incredible differentiation, the best of minds run into barriers; even at generalized levels, they can hardly understand one another. Then, once in a while, an Einstein arises, removing the barricades across branches of science, bringing order into isolated or obscurely connected events, and paving the way for others to follow. In the refining of theories, exploring this crevice and that, making all kinds of experimental and practical applications — cleaning up, as it were, after the clash of diverse and inconsistent findings — there is room for the bright university student, genius or not. This group of young persons, while large numerically, is a tiny fraction of the total population. It deserves society's constant support and encouragement. From its ranks will come those who are to go higher, together with a handful of pioneers — the quintessence of genius in a given generation.

GENIUS AND SOCIETY

As for the mathematician, physicist, chemist, biologist, or geologist, so for the practical sciences and arts that depend upon them; so, also, for saltatory accomplishments in the fine arts. There are times when an art or a science is so upsurging, as in Elizabethan literature or nineteenth-century biology, as to catalyze whole battalions of gifted youth. In modern, as in ancient, days this phenomenon is marked as a golden age to be followed by peace and plenty and understanding — the ever-upturning curve. In between are the longer dark ages that bury thousands of talented youth in an avalanche of neglect, ridicule, frustration, and despair.

Genius flourishes in a subtle confluence of what a nervous system has to offer and a society is willing to accept. Some of its products are semipermanent. They may be preserved in theorems, in art forms, or in the ways of science and human nature. Long after death, a man's rating can be reviewed, however obscurely received was the original deposit. It may be revised upward or downward, for what is achieved is a series of tests and retests over the centuries, with no finality. But we may postulate that a constant consideration by generations of men, under different social conditions, is in itself a hallmark of extraordinary achievement. This process, whether short or long, will be confined largely to a particular form of culture until such time as the various streams, for example in the European and Asiatic cultures, converge. Under modern conditions of communication and transportation, with an increasing awareness of the unity of intellectual and cultural groups over the world, we should experience a great acceleration of the merging process. Deep emotional satisfaction will come with the discovery of fine ideas and fine objects among diverse peoples, and with the reaffirmation of man's faith in himself and his works; this, finally, may be the answer to the classic plea of William James in behalf of a moral equivalent for war.

The drive of a person, family, state, or golden-age society toward a higher level of achievement is no direct function of the development of appropriate nervous systems, but at the higher levels there is a correlation. Musical talent is likely to be found in conjunction with musical energy — with a strong desire of the organism to react to musical forms and to attempt their construction. This process implies directly, or by derivation, certain emotional concomitants. The pressure of musically minded parents on the nonmusical child will lead to frustrating situations and emotional crises; conversely, the repressive attitudes of uninterested parents and teachers will lead to similar emotional entanglements. Ruthless persons can devise diabolical techniques of guidance and habit formation that will dissolve anything but the strongest will-directed talent — as we shall see, when the youth of captive European nations are able to tell their story. The men of art and science who survived to be known for their great works are a selected lot. Could they not be matched, potentially rank for rank, and in greater numbers, by those who had "the divine spark," but were born too soon, too late, in the wrong country, or under cannon-fodder conditions?

In the definition of intelligence, it will be recalled that the reference to emotions was worded in the negative — as a *resistance* to intrusive emotional blockings or distortions. This must not be confused with the pleasant or joyous stamping-in emotions that may accompany the realization of abstract ends, the discovery of a law, or the completion of a work of art. There is nothing intrusive about emotions that are timed and tempered consistently with the individual curve of production, permitting freshening interludes in the life of the scientist or artist, and adding strength to his long-time purpose. The medieval astronomer, flogged for scientific views not in harmony with religious dogma, deprived of the common protections of a decent society, could not go through this without emotional bitterness and soul-searching introspection. The nobility of idea and action said to arise out of persecution was a rare phenomenon: recanting has always been more common, together with the tragic deterioration that follows the wet finger to the wind and the quick ear to the ground.

The conscious aim of any powerful society is not to make martyrs of recalcitrants and heretics but to bring them within its own digestive process. At first the details of science, and soon its strong central structure of hypothesis and verification, come under the fateful influence of a political party, of nazis or fascists. From this pathological outcome scientists, individually and altogether, can save themselves only by stimulating, demanding, and fighting for the kind of social organization that lets ideas live. From the social scientist they must learn that the unscientific mind is rarely able to resist emotional distortions; to the easily led, they are in no sense intrusive factors, but pleasing experiences, habit-forming and natural. The scientist, particularly if highly gifted, must save others in order to save himself; he must do this by a rectification of his own thoughts and feelings, with enough of the latter to permit him to understand and engage the common man. For his part, the common man, *given a chance*, is as dependable as the scientist; he can learn to test theories and discoveries in relation to the simple, permanent, and universal wants of mankind.

GENIUS AND REPUTATION

Some men, long after any known test would assign to them high intellectual ratings, continue to make distinguished contributions. Following a series of graphs showing the average number of contributions to branches of medicine made at various chronological points in the career of research workers, Lehman[1] prepared a summary curve which is here reproduced. It will be seen that contributions to medicine are made most frequently by men still in their thirties, with a peak of productivity between thirty-five and thirty-nine. However, a substantial proportion of the total contributions were made by men beyond fifty, and there is no age up to ninety in which outstanding contributions are impossible. Lehman adds a note on the factor of social acceptance:

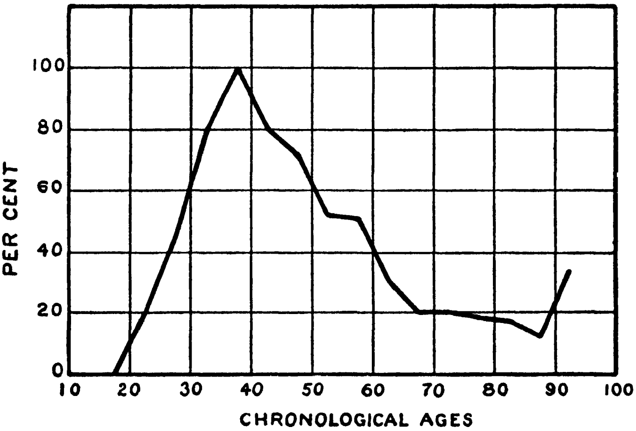

FIG. 34. Average Number of Advances in Medicine and Public Hygiene Which Were Made during Each Five-year Interval of the Contributors' Lives. This Graph Presents Data for 537 Individuals Who Made 801 Contributions. (From Lehman, p. 457.)

> In the field of medicine, as in other fields, man's progress has frequently been opposed by ignorance, bigotry, stupidity, ridicule, intolerance and the pressure of poverty. Religious beliefs too have often been a major obstacle to further immediate advance. Some potential contributors to medicine have perhaps been crushed by one or more of these hostile forces; others possibly have only been stimulated by them to fight more vigorously for their convictions. William Harvey reported on the circulation of the blood when he was past fifty, but there is evidence that he discovered this phenomenon some years earlier and delayed publication as a matter of precaution. Histories of medicine reveal that such delay in making announcements of new medical discoveries has been frequent. There often were very good reasons for withholding such announce-

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[1] Lehman, Harvey C.: The Creative Years: Medicine, Surgery and Certain Related Fields. *Scientific Monthly*, N. Y., 1941, 52, 450–461.

ments. For example, when Harvey finally published his discovery that the blood circulates in the human body his professional colleagues only jeered him and there was an immediate falling off in Harvey's medical practice. Many of his patients refused to be treated any longer by one who gave such clear evidence of what seemed to be obvious insanity. (p. 457.)

Reputation and IQ

By a curious inverse logic, there have been attempts to assign estimated IQ's to great men and women of the past and to buttress the assumptions with descriptive and biographical accounts of their childhood and youth. Of recent attempts, the work of Cox[1] is the most ambitious. There is no question about the extraordinary powers of many of the persons she cites, and there is ample evidence for the early appearance of extraordinary aptitudes. *The weakness lies in the attempt to interpret great and glorious accomplishments in terms of the crude currency of the intelligence quotient.* When we note that men like Balzac, Heine, Herder, Huygens, Molière, and Sir Isaac Newton are estimated to have attained to IQ's no higher than 130 in childhood, and we recall that any college campus is peppered with such "mental giants" — so far as the IQ is concerned — the incongruity of the whole procedure is apparent: it is of the same order as minute inferences from the penmanship, spelling, and punctuation of a Shakespeare. The pastime would be amusing, if there were not a tendency to consider the inferences reversible. If Molière in his childhood is assigned an IQ of 130, and at age twenty-six is still regarded (by "competent judges") as IQ 130, the whole concept of genius in relation to the IQ becomes meaningless — Molière and his IQ-equals probably have other minor traits in common, and what of it?

GENIUS AND PERSONAL STABILITY

Whether or not the "gifted," as defined in Binet testing, are stable or unstable is a totally different matter from any considerations of great men. The two samplings are not only different: we are not as yet sure of any substantial overlapping; there are so many gifted children and adults (that is, persons with high scholastic aptitude) that measures of physique, personality, and adjustment might reveal satisfactory conditions in the group, with scarcely any relation to genius. Still, even the scholastically "gifted" are not above suspicion, for in the Thirty-Ninth Yearbook, Terman stated[1] that from 30 to 40 per cent of the parents of gifted children reported "mental abnormality among near relatives." In view of a reluctance on the part of many persons to reveal family data, this is a lead that requires following up.

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[1] Cox, Catharine Morris: *Genetic Studies of Genius:* Vol. II. *The Early Mental Traits of Three Hundred Geniuses.* Stanford University, Calif.: Stanford University Press, 1926. Pp. xxiii, 842.

Of interest in this connection is an observation of Galton's[2] in a prefatory chapter written just fifty years ago:

> The relation between genius in its technical sense (whatever its precise definition may be) and insanity, has been much insisted upon by Lombroso and others, whose views of the closeness of the connection between the two are so pronounced, that it would hardly be surprising if one of their more enthusiastic followers were to remark that So-and-So cannot be a genius, because he has never been mad nor is there a single lunatic in his family. I cannot go nearly so far as they, nor accept a moiety of their data, on which the connection between ability of a very high order and insanity is supposed to be established. Still, there is a large residuum of evidence which points to a painfully close relation between the two, and I must add that my own later observations have tended in the same direction, for I have been surprised at finding how often insanity or idiocy has appeared among the near relatives of exceptionally able men. Those who are over eager and extremely active in mind must often possess brains that are more excitable and peculiar than is consistent with soundness. They are likely to become crazy at times, and perhaps to break down altogether. Their inborn excitability and peculiarity may be expected to appear in some of their relatives also, but unaccompanied with an equal dose of preservative qualities, whatever they may be. Those relatives would be "crank," if not insane. (pp. ix–x.)

There is no gainsaying the fact that many persons whose rank of genius appears durable were marked by persistent maladjustments — that there was, at times, every indication of psychotic involvement. To say that such maladjustment in itself contributes to the quality of the man would be farfetched, but there may be an association between the two tendencies. One of the marks of genius is the ability to drive through in support of original ideas and creations, contending against all obstacles. It is possible that the resistance of other persons or groups may strengthen the drive of the highly talented person, improving the quality and enlarging the scope of his work.

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[1] Terman, Lewis M., and Oden, Melita: Correlates of Adult Achievement in the California Gifted Group. The Thirty-Ninth Yearbook of the National Society for the Study of Education. *Intelligence: Its Nature and Nurture.* Part I. *Comparative and Critical Exposition.* Bloomington, Ill.: Public School Publishing Company, 1940. Pp. xviii, 471. (pp. 74–84.)

[2] Galton, Francis: *Hereditary Genius: An Inquiry into Its Laws and Consequences.* London: Macmillan & Company, Ltd., 1925 edition. Pp. xxvii, 379.

The man of genius rank, demolishing comfortable habits and loyalties, given to new ideas, to creation and discovery, and to the destruction of false gods, cannot expect to have an easy time of it among his fellow humans — not even if the soon-to-be-realized effect of his work is a great scientific, artistic, or social contribution. When confronted with a vista of better times and better lives, people cling to what they feebly like and are bored with — this above all: man hates to be disturbed.

PART IV

HEREDITY AND ENVIRONMENT

CHAPTER XIII

NATURE-NURTURE AND THE IQ

CONCERNING KELLEY'S VIEWS

We shall let this chapter begin with an invocation by Kelley:[1]

> Whereas I had for years engaged in vigorous argument with colleagues as to the parts played in mental life by nature and nurture, I found (I might as well admit it now) that I had never to myself clearly defined either term and, still more surprising, that I could not find in the literature any precise functional definitions. The demand that these and other related concepts be precisely defined in behavioristic terms is a cruel infringement upon freedom of debate and for the moment seems to threaten to take all the joy out of a problem which has long been an Elysian Field for the tired mind in a dogmatic mood. (pp. v–vi.)
>
> Someone may ask what meaning there can be in the term "native" when applied to such abilities as Arithmetic Reasoning and Spelling, in view of the fact that the very young child is possessed of zero ability and therefore of zero difference in ability in each. This is a puzzle, but it is of the same sort as that of two infants, a boy and a girl, one of whom later develops a moustache and the other does not. In this case both in the beginning manifest zero achievement and zero difference in the matter of moustaches. As we do not hesitate to attribute such a developed difference to nature, so here we need not hesitate to attribute a mental difference appearing late in life to nature. (p. 18.)

The developed hirsute difference is controlled by hormones that are sex-linked, both sexes possessing both types of hormones, but, on the average, in different amounts. The dichotomy is not perfect, for there are bearded women and beardless men. The question is, To what extent are these hormones under genetic control? Ordinarily the inherited forces predominate, but through infections, operations, and deteriorations the smooth course of development in the individual may be radically changed. By appropriate measures, the secondary characteristics of sex can be reversed in certain animals (such as the domestic fowl). If this can be said of a striking gene-affected phenomenon like sex, we have to be doubly on guard in lining up mental abilities according to their possible origins in nature or nurture. Differences should be held to stream directly from genetic lines if the physical channel can be demonstrated: color blindness and hemophilia are known to be inherited because the tissues involved meet the required expectations in genetic determination. But mental ability does not appear to follow such straight lines of prediction.

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[1] Kelley, Truman Lee: *The Influence of Nurture upon Native Differences.* New York: The Macmillan Company, 1926. Pp. vii, 49.

Kelley's view is that, for an individual, "maturity and chronological age are perfectly correlated." Measures of *differences* between abilities are uncorrelated with age. That is to say, maturity moves forward, while nurture works in either direction and in relation to the time interval. He holds that children are, on the whole, less alike than adults.

Kelley's conclusions are based on rather limited samplings of a population of American school children. For the eight-year-olds, the test materials (Stanford Achievement) covered such scholastic accomplishments as paragraph meaning, sentence meaning, word meaning, computation, arithmetic reasoning, and spelling, while for older children, tests in science, history, and literature were added. Without nurture there could be no achievement at all in these terms, for they are the products of our cultural environment. For practically all these children, nature had provided an organism able to cope with the elements of these subjects, such that in a standard school environment the appropriate capacities would be tapped. Since these children were living in a culture that regarded literacy as essential, they took on their new learning so naturally as to make it seem inevitable. Still, most of the forebears of these children, only a few generations back, were completely ignorant of the niceties of scholastic accomplishment called for in these tests; to put it bluntly, they could not, for the most part, even read or write.

Concepts of maturation with respect to physical growth, strength, health, and resistance to infection will always be related to such environmental realities as diet, exercise, radiation, and immunization. All that can be measured is a series of individuals in which gene-controlled forces have combined with environmental availabilities to produce the organisms being measured. It is possible, as Kelley has done, to restrict the concept of maturation so long as we do not lose sight of the fact that under differing biological, nutritional, and educational conditions, maturation tables would have to be revised. When everyone gets taller, norms and standards rise; when children as a whole learn faster and go farther, expectations rise in behalf of each child.

Literacy itself was once regarded as a major accomplishment; it was viewed as an individual deviation from a cultural norm. We now feel sure that, over the last six thousand years, literacy need not have been confined to an intellectual aristocracy: the rulers who kept the masses down were strongest in their contempt for mass inferiority. No one can hate the hungry like the withholder of food. Over the centuries literacy displayed an in-and-out relationship with royal prerogative. When learning was in favor, the young princes learned to read — practically all of them. This in itself was a tribute to the excellence of instruction, for some princes who later became kings would have felt at home in a feeble-minded institution. The hereditary right of kings was so confused with hereditary ability that only an outrageous departure from normality was discoverable — to be bruited about by brave souls possessing a degree of temporary invulnerability. The chief advantage of kings is not in their lineage; it is in the power, often neglected, to establish from birth upwards the right kind of protection and education.

THE PROBLEM OF INHERITANCE

To one leading question on heredity and environment, Jennings[1] supplies a compact answer:

> Which is more important for the characteristics of organisms, heredity or environment? Which is more important for the characteristics of man? Which is more important for the manufacture of automobiles, the materials of which they are made or the method of manufacture? This question is like the other. No single general answer can be given to either. For good results, both fit materials and appropriate treatment of these materials are required; good genes and fit conditions for their development. (p. 139.)
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> . . . Though they have large powers of adjustment, individuals differ genetically in their tastes, powers and aptitudes. Respect for

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[1] Jennings, H. S.: *The Biological Basis of Human Nature.* New York: W. W. Norton & Company, Inc., 1930. Pp. xviii, 384.

> individuality is the great contribution of genetics to the treatment and understanding of human beings. To attribute everything to heredity, as some have done of late, is doubtless even more harmful than to attribute everything to environment; for it promotes a fatalistic viewpoint, it discourages effort. But to attribute everything to the environment is to encourage the disastrous belief that parent and teacher can fashion all their unhappy subjects on a uniform plan; is to promote that neglect of individuality which made education and home discipline in past generations one long cruelty. (pp. 179–180.)

In the individual, heredity and environment are a part of the same process of growth. As I have said elsewhere:[1]

> It is essential to think of the contributions of heredity and environment, not as mutually exclusive or diametrically opposed, but rather as close-coupled factors whose impingement is mutually interacting. Environment does not act *upon* heredity (who would say that heredity acts *upon* environment?); rather various combinations of factors and forces, with different origins, produce measurable results in child development. (pp. 22–23.)

Can innate nature be disentangled from experience and nurture? The question has little meaning except in terms of structural manifestations. Much that is not social heritage is shared with the other animals. For example, in basic emotional mechanisms, what differs is not so much the internal organs, involving perception, glandular responses, changes in the blood stream, and muscular tensions, but the conditions under which strong reactions are set off. Different animals choose different objects to be avoided or approached; the choices are modified in accordance with the conditioning that comes from experience. To the extent that any structure, ability, or trait is given to a rat or a chimpanzee, it is no longer *characteristically* human; it is rather something shared by human beings. Rat learning is never human learning; if areas exist in common, this can be ascertained only by comparative researches on both species. If studies of the rat give clews to the profitable study of man, the gain is not directly in our knowledge of human behavior, but in research methodology. But superior controls in rat experimentation, as exemplified in simplification, freedom for adverse stimulations (one can kill a rat), a faster tempo of propagation and maturation, and a surer access to post-mortem materials, make rat studies a useful complement to human studies.

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[1] Stoddard, George D.: Research in Child Development. [In] *Educational Research: Its Nature, Essential Conditions, and Controlling Concepts.* American Council on Education Studies, 1939, Series I, Vol. 3, No. 10, Pp. 189. (pp. 20–50.)

Leuba, voicing a common hope among social scientists, says of man:[1] "he needs to distinguish between his fundamental innate needs, and those developed in him by his cultural surroundings." Is not this an impractical dichotomy? Habits that are learned or artificial may be as potent as anything "innate." An acquired habit can override "nature," since "nature" is so conceived as to permit the acquisition of habit — and so on round and round!

It is the nature of nature to tolerate wide variations in connection with environmental pressures; it is the nature of nurture to succeed with variations that are smoothly articulated with inborn characteristics. It is the sophist, clearly recognizable since early Greek philosophy, who tries to push us toward a single cause or set of causes. In human affairs everything is *nature*, if by nature is meant a chainlike process transcending the individual; everything is *nurture*, if by nurture is meant an ancient chemistry of environment preceding life on earth. Out of nonliving forms came the living — the organic out of the inorganic, with disjunctions only in terms of new functions through the reorganization of material.

Maturation is defined as the expected development of an organism within the normal range of stimulation. The difficulty revolves about the concept "normal." In corn it does not refer to the particular cereal needed for commerce, but to the living, reproducing corn plant. In the long run, it is neither normal nor abnormal for corn to be tall or short, thick- or thin-foliaged, big- or little-eared; nor is it normal for cattle to be permanently horned or hornless, tall or short, lean or fat. Is it then normal for man to be intelligent, that is, to bank upon his abstracting ability, conserving it by every possible means, including production for use? We have learned that in a sick society, men will not be allowed to think: thinking will be discouraged, discredited, or punished. On closer examination we find that a derogatory attitude toward thinking is itself the symptom of social pathology. *We cannot fundamentally disparage man as a thinking animal;*

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[1] Leuba, Clarence: The Need for a Systematic Survey of Innate Nature. *Psychological Review*, 1940, 47, 486–490.

we can only attack him when he seems not for us but against us. Left to themselves, men will think, and they will combine their thinking with that of others in order to produce social benefits. To restrain or delimit this notable human ability is a form of mutilation no less effective than the cutting off of heads.

For a plant viewed as a living organism, what criterion can there be except to go on living, generation after generation? For man, to go on living is not enough. For such a statement there is no proof; there is only the simple evidence that man alone is able to hold such concepts as *progress* or *retrogression.* In spite of plagues, wars, mental diseases, and unhappiness to the *n*th degree, man today will not envisage progress in terms of a return to the prelanguage, prethought days of his ancestors; no, not even if they were to be thoroughly saturated with animal pleasures and virtues. The modern man must also be intelligent. To be primitive, to go toward the primitive, is seen for what it is: not an invitation to substitute simple rugged virtues for present-day superficialities, but a bemeaning of the entire personal and social structure. We shall be glad to see simple virtues restored on a wide scale, but we refuse to identify them with simple-mindedness.

Inheritance is what is received in the form of genetic determiners at the moment of conception. The parent-child relationship is physical in that new cells are now formed in the continuous life line established in a remote past. As is well known, these cells reproduce themselves by division, carrying forward characteristics resulting from the new combination of split germ cells. Each characteristic is contained in the genes that are themselves regarded as minute entities within the nuclear chromosomes. An immense amount of work has been accomplished, particularly with plants and lower organisms such as the fruit fly, showing that these genes, in various complex combinations, form the basis through which are established the physical details of the new individual.

While it has been known for a long time that most physical traits are not dependent on a single gene, for some reason the doctrine sprang up that every trait had a particular gene. As Jennings said seventeen years ago:[1]

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[1] Jennings, H. S.: *Prometheus or Biology and the Advancement of Man.* New York: E. P. Dutton & Company, Inc., 1925. Pp. vii, 86.

> From the fact that the "unit characters" changed when a single gene changed it was concluded that in some ill-defined way each characteristic was "represented" or in some way condensed and contained in one particular gene. There was one gene for eye colour, another for stature, another for feeble-mindedness, another for normal-mindedness, and so on. Every individual, therefore, came into the world with his characteristics fixed and determined. His whole outfit of characteristics was provided for him at the start; what he should be was pre-ordained; predestination, in the present world, was an actual fact. Environment might prevent or permit the hereditary characters to develop; it could do nothing more. Heredity was everything, environment almost nothing. This doctrine of the all-might of inheritance is still proclaimed by the popularizers of biological science.
>
> But this theory of representative particles is gone, clean gone. Advance in the knowledge of genetics has demonstrated its falsity. . . . Neither eye-colour, nor tallness, nor feeble-mindedness, nor any other characteristic, is a unit character in any such sense. There is, indeed, no such thing as a "unit character" and it would be a step in advance if that expression should disappear. (pp. 16–18.)
>
> The genes then are simply chemicals that enter into a great number of complex reactions, the final upshot of which is to produce the completed body. The characteristics of the adult are no more present in the germ cells than are those of an automobile in the metallic ores out of which it is ultimately manufactured. To get the complete, normally-acting organism, the proper materials are essential; but equally essential is it that they should interact properly with each other and with other things. *And the way they interact and what they produce depends on the conditions.* (pp. 27–29.)
>
> Any characteristic requires for its production both an adequate stock of chemicals and an environment adequate for its production through proper interaction of these chemicals with one another and with other things. In these senses all characteristics are hereditary and all are environmental, but no characteristic is exclusively hereditary or exclusively environmental. (p. 48.)

In short, heredity may be said to make choices, depending upon environmental stimulations and possibilities; environment may be said to make differences, within the limits of potentiality in the organism. That no part of the genetic process is simple, is emphasized by the complex role played by the cytoplasm which Jennings[1] describes as "the medium in which the genes live and operate." The genes and the cytoplasm interact over the years, producing a vast complexity of organic outcome; in this exchange, the role of the cytoplasm is not passive. Thus, in a sense, the cytoplasm is an environment for the genes, presenting a material and a structure with which the gene reacts. The cytoplasm does not transmit its influence down through a series of particular physical events, nor is its power predictable.

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[1] Jennings, H. S.: *The Biological Basis of Human Nature.* New York: W. W. Norton & Company, Inc., 1930. Pp. xviii, 384.

Obviously few *forms* representative of child or adult are present at conception; what is given is direction and probability — a growth-goal that is dramatic as to exclusion and inclusion: the human fetus will never become fish, frog, or fowl, however much it may at first resemble these humble animals. As a fetus, it is a growing organism intimately combining its hereditary forces with a physicochemical environment. Its mechanism of heredity is revealed in terms of an observable pattern of growth and behavior, and in no other way. There is no little physical trait in the germ cell nor any sure-fire capacity in the growing organism, but there is, under proper conditions, a controlling force working toward general structural ends in organic maturation. This is the great unfolding power so frequently referred to in biological literature. Throughout this development, the germ cells themselves have been segregated in function and location. That they are not completely impervious to external happenings has been shown in the work of C. C. Little and his associates on the appearance of cancer in rats.

The early-segregated germ cells in a given individual are the organism's contribution to forthcoming generations. The classic question, usually decided in the negative, is this: Can events in the organism have direct effects upon these cells, thus modifying the structure of organisms in succeeding generations? More explicitly, Are environmental modifications transmitted in the genes? In the early days of scientific genetics, experiments were somewhat naïvely conceived: tails of rats were cut off down through many generations to see if the new genes would call for no-tail, or at least short-tail, rats. Any concept of a one-to-one relationship, whether regarded in physical or behavioral terms, proved to be fallacious: acquired characteristics could possibly affect the next generation only to the extent of demonstrable change in the germ cells, since nothing else was passed on. Whatever forces, presumably physicochemical in nature, can penetrate these closely guarded cells, altering their composition, possess, by definition, the power to change the next generation, if not to eliminate it. Examples of forces that affect all body tissue, to which not even germ cells are immune, are found in the complexities of nutrition, infection, and radiation. In short, the whole question needs to be restated in such a way as to give prominence to the modern idea of the organism as a whole. Nowadays there need be no traditional or religious pressure against any hypothesis; the final answer will be furnished by the scientist alone.

CURRENT VIEWS IN PSYCHOLOGY

This general question of the inheritance of acquired characteristics is rarely raised in present-day studies of human intelligence. Once in a while it is dug up as a dead body to be flayed dramatically by a few psychologists who are worried about the possibility of developing men from apes. They like to think of intelligence as a one-gene affair (which it is not). To get into this dilemma is to deny two principal characteristics of intelligence — its complexity of supporting physical mechanism (the nervous system) and its slow development in the individual. If it takes dozens of genes to determine the outcome of eye color or wing length in the infinitesimal fruit fly, how many should be postulated for the human brain? If the fly will become what his genealogy calls for, only if elaborate environmental controls are maintained, what of the analogous process in human tissues?

Surely the extravagances of psychologists would be amusing if they were not seriously advanced. We have it from Thorndike himself that no environmental impact will make a man out of a chimpanzee; this, I think, is well known and hardly within the scope of our immediate endeavors. But from that point onward even the scientific mind is likely to descend into error: that since we cannot make a chimpanzee into a man, we cannot make a chimpanzee into a better chimpanzee, or a human child into a better man. The platitude has long had preference over the data. Too often it is said, "You cannot make a silk purse out of a sow's ear." Apart from the fact that industrial chemists have succeeded in making a handsome silk purse out of a sow's ear and nothing else, we should question the basic premise as indicated above: *we can make a silk purse out of what we thought was a sow's ear.*

Too often in the past, writers following Tredgold or Burt[1] have *defined* a feeble-minded child as one who could never be anything else:

> By intelligence, the psychologist understands *inborn, all-round, intellectual ability.* It is inherited or at least innate, not due to teaching or training, it is intellectual, not emotional or moral, and remains uninfluenced by industry or zeal; it is general, not specific, that is, it is not limited to any particular kind of work, but enters into all we do or say or think. Of all our mental qualities it is the most far-reaching; fortunately it can be measured with accuracy and ease. (pp. 28–29.)

Some, like Thorndike, would give over everything to man's genes: "And, after all, man's genes made the environment which now fashions him."[2] This led to the remark:[3] "And at first there were no genes, but only environment; the environment made them." The same point was referred to by Sanders:[4]

> One of the fallacies that the Neo-Darwinian commits in his deduction of the greater importance of heredity over environment is that he forgets that the germ plasm, which he considers the bearer of heredity, has evolved. By accepting the genetic make-up as identical with heredity the Neo-Darwinian tacitly assumes that the germ plasm in the past has evolved independent of its environment; in other words, he assumes the very thing that he attempts to prove. (pp. 22–23.)

Some workers who are clear on most of the implications of the new findings with respect to the IQ may slip into this mental dilemma. Thus, G. L. Freeman [5] remarks as follows:

> . . . whereas most people once assumed that tested intelligence measured the "native" factor more than a "nurture" factor, they now must concede that it is greatly determined by cultural influences to which the testee is exposed. There is nothing new or strange in

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[1] Burt, Cyril, Jones, Ernest, Miller, Emanuel, and Moodie, William: *How the Mind Works.* New York: D. Appleton-Century Company, Inc., 1934. Pp. 336.

[2] Thorndike, E. L.: *Human Nature and the Social Order.* New York: The Macmillan Company, 1940. Pp. xx, 1,019. (p. 305.)

[3] Stoddard, George D.: Nostalgia, 1941 (A Review of *Human Nature and the Social Order,* by E. L. Thorndike, New York: Macmillan, 1940. xx + 1019 pp.) *Journal of Higher Education,* 1941, 12, 111–114. (p. 112.)

[4] Sanders, Barkev S.: *Environment and Growth.* Baltimore, Md.: Warwick & York, 1934. Pp. xviii, 375.

[5] Freeman, G. L.: A Methodological Contribution to the Nature-Nurture Dilemma in Tested Intelligence. *Psychological Review,* 1940, 47, 267–270.

> this doctrine, and anyone who has thought through the implications of a measuring device whose most reliable part is the vocabulary test, will have realized years ago that aside from the broadest limits of idiocy and genius, the "native" factor in intelligence may be effectively masked by differences in experience. (p. 267.)

He then rightly points out the wishfulness in thinking that "one can make a genius out of almost any unit of human protoplasm." Having said this, he gets off the track: "We shall be wasting even more public money than we now do in trying to bring all persons to an equivalent level of intellectual attainment." (p. 268.) Of course, *optimum* is the watchword — not *equivalent,* nor *high,* nor even *average.* Would not the bringing of each child to his highest development along physical, mental, and social lines justify a large expenditure of public wealth?

In order to account for all types of mental growth curves which, for individual children, show constancy, acceleration, deceleration, and fluctuation, workers have called upon hereditary, constitutional, and environmental influences. The least that can be said in this connection is that, at any age, heredity permits, if it does not actively contribute to, a wide shift in IQ. Since environmental forces may be positive, negative, or partially counterbalancing, differential effects may be produced at different age ranges or under differing conditions. Hereditary forces, if operating to produce variations at a given period in organic development, must always be moving in a given direction; otherwise, for intelligence at least, there could be no meaning to the inheritance of relative status. In a growth continuum like intelligence, the force of heredity can neither be laid aside nor postponed; it is always there, setting up its limitations as well as its potentialities. To say that heredity is such a pattern as to demand, for a given individual, acceleration, deceleration, or constancy is to deprive heredity of any special force at all.

THE PROBLEM OF ENVIRONMENT

Thus far the relationship between environment and intelligence, as in preschool or foster home situations, lacks clearness. Even so, progress can be made, perhaps in a fashion analogous to that of the early days of nutritional research. It had become well established through experiments in feeding rats, guinea pigs, and children that certain diets were favorable for growth and health, conversely that the lack of certain chemical components was harmful or fatal. When biochemists, physiologists, and pharmacologists set about to get a more exact knowledge of the particular ingredients that led to measurable results, the feeding experiments properly were kept up. The vitamin in pure form does not exist in the tissues of an organism; in the gross physiology of the organism its effects may not conform to precise chemical or mathematical expectation. In fact there may be reciprocal, combining, and neutralizing effects, let us say, among vitamins, hormones, and other chemicals to such a degree as to defy quantitative analysis. But the studies of rat growth and behavior clearly demonstrated organic happenings in relation to diet, far in advance of the precise solution of chemical problems.

We can give to an environment a "mental stimulation value," as proposed by Wellman,[1] expressed entirely in terms of measured effects upon Binet intelligence (scholastic aptitude) under standardized conditions. An environment highly saturated with what are presumed to be stimulating experiences may be set off against controlled impoverishment in such a way as to assure, for a given sampling of children, a reasonable inference of causality in the relationships discovered. To hold out for mental stimulation measures, as Dulsky[2] does, that are independent of observed and measured changes in a child's behavior is to get into a logical circle; it is like trying to prove that carrots are good for rabbits without feeding the rabbits.

In the individual child, nature and nurture are interwoven from the beginning. A child is obviously a product of the two, even though in the prenatal period the environmental influences are chiefly biochemical. While in early compilations of research, such as the Twenty-Seventh Yearbook of the National Society for the Study of Education,[3] this fact was recognized, no emphasis was given to it. The studies were organized with the thought that nature and nurture could be separated in so far as differential effects were concerned. This led to research based largely on variations and correlations, studies of twins offering the most representative pattern.

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[1] Wellman, Beth L.: Our Changing Concept of Intelligence. *Journal of Consulting Psychology*, 1938, 2, 97–107.

[2] Dulsky, Stanley G.: A Functional Concept of Intelligence: Comments on Our Changing Concept of Intelligence, by Beth L. Wellman. *Journal of Educational Psychology*, 1940, 31, 641–652.

[3] National Society for the Study of Education: The Twenty-Seventh Yearbook of the National Society for the Study of Education: *Nature and Nurture*. Part I. *Their Influence upon Intelligence*. Part II. *Their Influence upon Achievement*. Bloomington, Ill.: Public School Publishing Company, 1928. Pp. ix, 465; xv, 397.

As will be pointed out in the next chapter, the study of twins was not pushed to its logical limits. It is necessary to begin with identical twins, since fraternal twins are genetically no more alike than other siblings. The assumption for identical twins is that "nature" is the same for both: the one egg and the one sperm have produced two individuals whose genetic constitution is identical. Does not this mean that *all* departures from identity, whether in physique, mentality, or behavior, are ascribable to environmental influences, or, at least, that some aspects of general innate control are indeterminate as to the extent and chronology of development?

Let us look at the breaking point in the nature-nurture dichotomy. It is all right to call some factors *constitutional* in the sense that they are peculiar to a given organism rather than dependent upon a particular gene combination or upon an environmental impact available to other organisms. Such matters as chemical differences in the fetal blood supply, asymmetry in the embryonic stages, and the mechanical placement of twin fetuses are illustrative. These factors are not genetic unless established as such, nor are they environmental in the usual sense of the term. Nevertheless if we must make a clean break as between nature and nurture, it must be done on genetic grounds; some constitutional factors then become a special order of environmental influence. They will be studied primarily by the biochemist, the physiologist, and the pathologist, although their final effects in the maturing organism may be observable as behavioral differentials. Thus the fetal ingestion of thyroxin, which is largely iodine, affects not only the gross anatomy of the organism, but the early and ultimate growth patterns of the behaving individual.

While differences between identical twins are assigned to nurture, the reverse of the proposition does not hold: similarities among twins may or may not be ascribed to nature. Common sense, as well as scientific data, leads us to say that the deterministic factors in identical twins are stronger in regard to physical traits, such as eye color, hair quality, and physiognomy, than for mental and personal characteristics. It is commonly observed, for example, that environmental dissimilarities in nutrition, exercise, and social pattern do not erase, although they may modify, the striking physical resemblance of some identical twins. That this physical resemblance itself is the chief basis for determining the fact of identity, I have brought out in a review of Newman, Freeman, and Holzinger[1] as follows:

> . . . careful work [was] done to discriminate between identical and nonidentical twins. Ten criteria were established, and measurements and observations were carefully taken. They related to such items as hair-, eye-, and skin color, facial and dental features, characteristics of hands and fingers, and closeness of cross resemblances between twins. Yet as one reads through the monograph, the impression is gained that all these criteria may be summed up in item number one which they formulate as follows: "(To be classed as monozygotic or identical) twins must be so strikingly similar in general appearance that they are likely to be mistaken one for the other." This impression comes largely through the utilization of pictures and the recording of notes on the general similarity of twins who have been reared apart. In this sense the more refined measurements referred to above are primarily technical corroborations. They are decisive in those cases in which the criterion of general physical similarity is doubtful. (pp. 145–146.)

The work to be reported in Part IV is not on a grand scale; its reference is to the development of individual children under differing environmental conditions. When IQ's move upward or downward nobody knows whether anything has happened to the germ cells. Nothing could happen unless the nervous changes that are postulated in support of changing ability partake of a general organic phenomenon. Germ cells live and die in conjunction with the whole cell system; it may be that they share in certain organic relationships.

Any search for effects upon germ cells should involve the following conditions: (*a*) concentrated environmental impacts, long sustained; (*b*) observation and measurement of organic changes in the life history of the individual; (*c*) a full pedigree for the animals utilized in breeding; and (*d*) a continuation of the study through many generations. Only after such work has reached a high point in experimental excellence can we expect to undertake studies of the more subtle genetic aspects of human behavior and adjustment. Certainly the final application to human conditions will be handicapped by the lack of genetic knowledge available, the barrier against close breeding, and the necessity of restricting experimental impacts to those that are deemed favorable.

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[1] Stoddard, George D.: [A Review of] Newman, Horatio H., Freeman, Frank N., and Holzinger, Karl J. *Twins: A Study of Heredity and Environment* (Chicago: University of Chicago Press, 1937). Pp. xvi, 369. *Journal of Educational Research*, 1937, 31, 145–147.

FROM BINET TO POPENOE — AND RETURN

While the biologically trained eugenist is careful not to go to extremes, he may nevertheless beg the question of the relative influence of nature and nurture. Popenoe may be cited as an example. He says:[1]

> Intellectual development despite seclusion offers a strong argument in favor of the inborn potentiality, as against the "clean slate" idea of the child mind. Such cases are naturally rare, and when found they are often vitiated by the fact that the stock is mentally abnormal; for normal people do not keep their children immured. Occasionally, however, an instance comes to light that is significant.
>
> Such a one is that of John Henry, who had practically no school training (he had barely learned to read); practically no contact with other children, and no home education save what he may have picked up for himself from a few religious books and a stray copy of a newspaper. He was kept indoors by an eccentric mother; half starved and wholly ill-treated. Yet when rescued at the age of 15, he tested up to age (1.04 on the point scale, 98 on the Binet). If his mental level was inborn, this is easily understood; if a product merely of opportunity, it is inconceivable. (pp. 140-141.)

The exact dynamics in cases of this sort are obviously difficult to trace. One religious book (The Bible) might have been available to the child; if so, it would have offered a tremendous storehouse of language and thought. Malnutrition may not have a direct effect on growing intelligence, and some kinds of ill-treatment will drive a boy into more abstract realms. But these details, while important in any cases reporting exceptional accomplishment under impoverished conditions, are not the crucial point in

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[1] Popenoe, Paul: *The Child's Heredity.* Baltimore, Md.: The Williams & Wilkins Company, 1929. Pp. xiii, 316.

Popenoe's observation. What is important is this: it is regarded *ipso facto* as extraordinary that he reached an IQ of 98 on the Binet. There is no evidence to indicate that this same boy, under fine educational conditions over a fifteen-year period, might not have reached an IQ, let us say, of 150. It is this hidden, unmentioned-goal IQ that vitiates Popenoe's argument; it has nothing to do with a clean-slate idea — a hypothesis that has never been sustained by scientific workers.

Popenoe's case is the modern version of a series of tales that have come down through our social history. As Waddington[1] remarks:

> James the Fourth of Scotland is said to have performed the experiment of isolating a young child on an island in the Firth of Forth; when visited some years later he was able to speak good Hebrew. (p. 348.)

In 1938, with special reference to the interests of school people, I wrote the following:[2]

> The school, in elaborating its democratic principles, does not assert that all children are born mentally equal or that they may ever become equal. But it does hold rightly that out of any family or any community may arise almost any level of intelligence. To the extent, therefore, that a social hierarchy based on mental ability is desirable (through mounting advantages and responsibilities for the mentally able), the search must ever be in all sectors of the population. Very likely the early educational leaders did not know this or did not believe it. Their idea of the public school arose out of social and political doctrine, and it is just one of the fortunate accidents of our culture that their planning, excellent on its own grounds, should contribute also to the discovery and conservation of mental talent. (p. 427.)

The hub about which studies in the 1928 Yearbook[3] revolved was stated in the Yearbook:

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[1] Waddington, C. H.: *An Introduction to Modern Genetics.* New York: The Macmillan Company, 1939. Pp. 441.

[2] Stoddard, George D.: Contributions to Education of Scientific Knowledge About Mental Growth and Development. Thirty-Seventh Yearbook of the National Society for the Study of Education. Part II. *The Scientific Movement in Education.* Bloomington, Ill.: Public School Publishing Company, 1938. Pp. xii, 529. (pp. 421–434.)

[3] National Society for the Study of Education: The Twenty-Seventh Yearbook of the National Society for the Study of Education: *Nature and Nurture.* Part I. *Their Influence upon Intelligence.* Part II. *Their Influence upon Achievement.* Bloomington, Ill.: Public School Publishing Company, 1928. Pp. ix, 465; xv, 397.

> When the relative contributions of nature and nurture are discussed, no doubt should be left in the mind of readers that contributions to *variability* are being considered. (p. 23.)

This refers to variability in scores. The question was, how much of twin *difference* is due to nature or nurture, not how much of *each twin* is so assignable.

The rearing of twins together or apart will make no difference whatever in their nature; the only presumption is that if the twins are reared apart, the environmental forces will differ more. The *hereditary* aspect of intelligence is of exactly the same stuff as the *hereditary* aspect of physique; for identical twins, differences cannot be in the mechanism of heredity, but only in the efficacy of the patterns handed down. Eye color, hair whorls, and length of nose are one thing; vocabulary, conundrums, and general information are quite another, as we discover when we apply our measurements to the two sets of data. Anything that is genetic in intelligence should be just as physical and as predictable as anything that is genetic in eye color, but the difference in *total* genetic determinism may be enormous. Most environments do not change the eye color (to say what would happen under radical changes in nutrition, light, and radiation would be to go beyond the data), for it is not a function of an observable growth continuum. Intelligence is different; it is a pattern of growth observable only in derived, culturally determined units.

What we need is not a genetics of mental ability, but a genetics of nervous structure. Lacking this in the human organism, we have been led into error by assuming an over-all genetics for behavioral manifestations. It is as if we tried to manufacture a car without knowing how to make a spark plug, a cylinder, or a differential. Nor should we jump to the conclusion that, once having established a sound human genetics in anatomical and physiological conformations, we should then be in possession of the fundamental framework for the prediction of behavior. The further difficulties involved in such an assumption are brought out in Part I of this volume. For any individual, it is only by the widest use of inference, analogy, and suggestion that we can get from the brain to the thought, and from the thought to a mastery of its development which is the growing intelligence of the organism. Gene-controlled or not, the brain cells are baffling.

In our present state of knowledge, human "genetics," shorn of this physical and mechanical linkage, but applied directly to behavior patterns involving the highest abstract forms, has been spun out in a manner that could be termed hilarious, were it not used by the elite to buttress social privilege.

It is easy to show that Binet did not regard his tests as measures of innate and fixed capacities. Shortly before his death, he held stoutly to a belief in the improvability of intelligence:[1]

> Quelques philosophes récents semblent avoir donné leur appui moral à ces verdicts déplorables en affirmant que l'intelligence d'un individu est une quantité fixe, une quantité qu'on ne peut pas augmenter. Nous devons protester et réagir contre ce pessimisme brutal; nous allons essayer de démontrer qu'il ne se fonde sur rien. (p. 141.)
>
> Maintenant, si l'on considère que l'intelligence n'est pas une fonction une, indivisible et d'essence particulière, mais qu'elle est formée par le concert de toutes ces petites fonctions de discrimination, d'observation, de rétention, etc., dont on a constaté la plasticité et l'extensibilité, il paraîtra incontestable que la même loi gouverne l'ensemble et ses éléments, et que par conséquent l'intelligence de quelqu'un est susceptible de développement; avec de l'exercice et de l'entraînement, et surtout de la méthode, on arrive à augmenter son attention, sa mémoire, son jugement, et à devenir littéralement plus intelligent qu'on ne l'était auparavant, et cela progresse ainsi jusqu'au moment où l'on rencontre sa limite. Et j'aurais encore ajouté que ce qui importe pour se conduire de manière intelligente, ce n'est pas tant la force des facultés que la manière dont on s'en sert, c'est-à-dire l'*art* de l'intelligence, et que cet art doit nécessairement s'affiner avec l'exercice. (p. 143.)
>
> Charmé de ces résultats, mais me défiant encore de moi-même et de mes collaborateurs immédiats, j'ai voulu faire appel au contrôle d'autres personnes, j'ai prié un directeur d'école d'aller tous les six mois dans nos classes d'anormaux, afin de mesurer à sa manière les progrès réalisés dans l'instruction. Ses appréciations et ses mesures ont confirmé les nôtres. Décidément, le progrès est net, incontestable, et même très grand. Veut-on un chiffre? Admettons que tous les enfants d'une classe d'anormaux y sont entrés avec un retard de trois ans dans leurs études. Au bout d'un an de stage, mesurés à nouveau, ils ne montrent plus qu'un retard de deux ans. (p. 145.)
>
> L'esprit de ces enfants est comme un champ pour lequel un agronome avisé a changé le mode de culture; résultat: au lieu de

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[1] Binet, Alfred: *Les Idées Modernes sur Les Enfants.* Paris: Ernest Flammarion, 1911. Pp. 346.

> friches, nous avons maintenant une récolte. C'est dans ce sens pratique, le seul accessible pour nous, que nous disons que l'intelligence de ces enfants a pu être augmentée. On a augmenté ce qui constitue l'intelligence d'un écolier, la capacité d'apprendre et de s'assimiler l'instruction. (p. 146.)

That the inheritors and revisers of Binet's tests did not follow Binet's view on the plasticity of intelligence is well known; they seized upon the practical outcomes of his work, while ignoring the conceptual base upon which it stood.

The common viewpoint is typified by Cunningham:[1]

> The consensus of opinion among psychologists who have made a study of environment in relation to intelligence rating, is that a *remarkable degree* of stimulation in the home background, or on the other hand, an *equally remarkable lack* of stimulating environment, may raise or depress the *measured intelligence* of a child. The best possible environment cannot, however, make a child intelligent if he has been born with a limited capacity to learn, nor can an exceptionally limited background retard a natively superior child to such an extent that he would be rated dull on a well-selected test. (pp. 109–110.)

Such statements have operational difficulties. In order to use the terms *born with* or *natively*, we need the application of a measurement to this concept. The questions are, What measurements, and under what conditions? Is there a way of inferring capacity to learn, native or not, apart from the measurements taken at a given time?

Lorimer and Osborn[2] supply a needed corrective:

> It is important to recognize at the start that "intelligence," as measured by mental tests, is something far more fundamental than mere accumulation of information, but nevertheless something that is, in part, the product of environmental forces and that can only be measured through the medium of responses that have been, in part, socially conditioned. Intelligence is ability to deal systematically with symbolic materials, such as words and numbers, or to organize concrete materials in space and time so as to carry out definite aims or directions; it is, in short, the ability to learn and to reason. Yet such an ability at any time in the life of an individual

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[1] Cunningham, Bess V.: *Family Behavior: A Study of Human Relations*. Philadelphia, Pa.: W. B. Saunders Company, 1936. Pp. 471.

[2] Lorimer, Frank, and Osborn, Frederick: *Dynamics of Population*. New York: The Macmillan Company, 1934. Pp. xiii, 461.

> is a developed ability. It is determined in part by hereditary physical factors and in part by the habits of life of the family and the community in which the individual has been brought up. For this reason we shall constantly refer to the trait that we are considering as "cultural-intellectual development." Many may consider this term unnecessarily awkward. Most psychologists will probably feel that we overdo this constant iteration of the rôle of cultural patterns in influencing intelligence test performance. Nevertheless, in view of the widespread popular misinterpretation of "I.Q.'s" as immediate indices of innate abilities, we feel that this constant reference to the cultural aspect of intellectual development is warranted. (pp. 113–114.)

We should not quarrel with statements to the effect that children who are extremely feeble-minded should be segregated, and that special educational opportunities should be offered bright children at the other end of the curve. The point of departure is that we can tell which are the feeble-minded children (except in the case of extreme defect) and which the average or bright only by exposing all children to favorable environmental influences. Under these conditions, some children will not grow fast enough or get far enough to reach the level of prudent reasoning demanded for a normal economic and social life. These defective children need protection and guidance. As they grow into adults they will be found, under benevolent care, to be self-supporting and capable of living peacefully with others.

On the other hand, for the brightest children to develop their potentialities and to fit into a society that will not necessarily like them, it is crucial to consider the kind of freedom for scientific application, creative achievement, and social reconstruction that high talent may demand. We have been able to maintain so much of the medieval in our educational, social, and religious life only because good minds, as they developed, were carefully routed through safe channels, later becoming the defenders, if not the prophets, of things-as-they-are.

Recent textbooks, important because they tend to fix knowledge and determine attitudes for countless college sophomores, have run the gamut with respect to the controversial aspects of the nature-nurture problem. There is, however, a noticeable departure from flat statements about the constancy of the IQ and the inheritance of intelligence, together with a tendency to explore somewhat the meaning of intelligence and the validity of mental testing. There is a slight but healthy shift toward an expectation that the young student himself may profit by a familiarity with firsthand data, thus enabling him to keep serene amid the cross fires of aroused commentators.

CHAPTER XIV

STUDIES BASED ON THE IQ

We may now consider a few studies that appear to give a new direction to much of the thinking on human intelligence.

STUDIES OF TWINS

In a substantial monograph on twins, Newman, Freeman, and Holzinger[1] hold to the concept of two types of twins, the identical who are developed from a single egg, and the fraternal, developing from two eggs, the latter being no more alike genetically than any other siblings. While various criteria were utilized to distinguish between identical and nonidentical twins, it is clear, as was pointed out in the preceding chapter, that the global judgment of observers as to general physical resemblance was the chief factor. The principal data of the authors center in fifty pairs of identical twins who were reared together, fifty pairs of fraternal twins reared together, and nineteen pairs of identical twins who had been reared separately. In each paired comparison, the sex was the same. The age range was from eight to eighteen years. As the identical twins grew up in the same environment there was a slight tendency for them to become less alike; for fraternal twins this divergence was more significant.

The unique portion of the study consists in measurements of nineteen pairs of identical twins reared separately over a long period of years. Most of the separations between the twins had taken place in the first year of life, although there were a few instances in which the twins had seen each other or had corresponded. The relevant materials are cited in Table 17.

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[1] Newman, Horatio H., Freeman, Frank N., and Holzinger, Karl J.: *Twins: A Study of Heredity & Environment.* Chicago, Ill.: University of Chicago Press, 1937. Pp. xvi, 369.

TABLE 17[1]

CORRELATIONS OF TWIN DIFFERENCES ON CERTAIN TRAITS WITH ESTIMATED DIFFERENCES IN THREE ENVIRONMENTAL RATINGS

Traits	*Environmental Difference Rating*		
	Educational	*Social*	*Physical and Health*
Height	− .02	− .01	− .18
Weight	− .10	.23	.60
Binet IQ	.79	.51	.30
Otis IQ	.55	.53	− .23
International Test	.46	.53	− .03
American Council Test	.57	.32	.08
Stanford Educational Age	.91	.35	.14

These figures lend validity to the authors' conclusion that "differences in educational and social environment produce undeniable differences in intelligence and scholastic achievement as measured by our tests." The ratings on environment were based on a composite of five judges. While the number of cases is small, in a given decade the total number of such cases in the country is also small. Any selective factor in the cases that the Chicago investigators were able to bring together for measurement would revolve about the physical appearance of the twins: the method of discovering these twins would be less effective for twins that did not resemble each other.

Perhaps this study furnishes the best evidence we have in support of mental differences in relation to differential environmental experience. What we should avoid (the authors of the study concur in this) is the idea that these particular correlations or estimates of influence are typical of what would be found, were the conditions of measurement and analysis closer to the optimum.

The factors that are relevant to all such studies are these:

(1) An early measurement, at the age of two or three years, of the intelligence of twins who are judged identical or fraternal, with a follow-up testing for all children. From such a sampling could be selected subsequently the very small group of twin-pairs that would turn up in separate environmental surroundings.

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[1] From Newman, Freeman, and Holzinger, p. 340.

(2) Biological criteria that would establish the identity of twins without recourse to "general appearance."
(3) A study of prenatal conditions in multiple births.
(4) The development of mental tests that get beyond scholastic aptitude.
(5) A measurement of the dynamic aspects of environment — to include better estimates of the effects of nutrition, disease, emotional upset, and complex learning experiences.

It may be that researchers in this field have missed a good lead; once having established, by all available criteria, that two infants are identical twins, it is of the highest importance to study under experimental circumstances the amount of divergence in development and behavior that can be established between the two. In such a case we have more than a statistical norm or artifact; we have the actual measurable limits of environmentally produced differentiation. What can be done for one pair presumably can be accomplished again, if we discover and utilize the forces at work. Even as things stand, with no systematic program of impacts, there may develop extreme differences between identical twins. This approach turns the question around: not, how much alike are twins on the average (since likeness is a mixture of genetic and environmental factors), but how far can we go in producing differences? Clearly the case studies of Newman *et al.* indicate the possibility of a large amount of shifting in mental status for twins who are judged identical. This shifting, except for a few cases of extreme environmental divergence, may be regarded as far from its maximum. Such a limit, as it is approached, will really be the limit of the determining factors bound up in genetic potentialities, for in identical twins we have nature at its strongest. As we go from twins to siblings, from siblings to child-parent, to child-cousin, and to child-grandparent, and so across and down the path of genetic dilution, the whole force of heredity will take its rightful position as cause in human behavior.

If identical twins were reared together and, in theory, exposed to exactly the same prenatal conditions and environmental forces from day to day and year to year, including equal emotional experiences, presumably no differences would be found between them; we should have the perfect picture of nature and nurture collaborating to restrain differentiation. If we now take the theoretical case of identical twins with no environmental points in common, the picture changes markedly. Under conditions short of pathology, the twins might have much in common physically, such as blond hair, blue eyes, and thin lips. None of these has ever been found to be predictive of intelligence. From such a pair there might come, in the best environment, one average child or possibly a superior child, the restrictions being hereditary. But for the twin-mate in a truly deadening environment, the outcome would be dullness to some degree — with no change upward from this condition except in relation to genuine opportunity for abstract cultural exchange; such a child, for example, might remain completely illiterate. We cannot avoid this dilemma by claiming that, nevertheless, this child's organism is intact and at any time capable of being restored to some measure of intellectual accomplishment, perhaps even to a high-grade status. (Certainly his chances of so developing will be far above those of another child in a fine environment who none the less has been diagnosed as an imbecile — with all the physiological defectiveness that this term usually implies.) What is indeterminate is not the mental measurement of such a twin, which could place him in a low category, but the residual plasticity of the organism. This can be estimated only through actual educational experiment. Test results, as we shall see, permit us to say that impoverishing conditions reduce intellectual status, leaving open the question of final status in relation to intervening environmental happenings.

INSTITUTIONAL ENVIRONMENTS

Crissey's findings[1] on mental development are based on samplings of children in four Iowa institutions: an orphans' home, a juvenile home, and two schools for the feeble-minded. The following children were excluded from his test-retest comparisons: children over sixteen years of age, colored children, epileptics, idiots and low imbeciles, and cases showing physical anomalies. For the most part, the Stanford Revision was utilized, but a few Kuhlmann tests were given for children whose mental age on the Stanford Revision was below three years. Children in the different institutions were matched at the beginning of the study. Crissey was interested in discovering what happens to the mental development of children when they remain in a particular institution or when they are shifted from one institution to another, as for example, from a school for dependents to a school for feeble-minded, or vice versa. He reports that, in general, there is a loss in IQ with continued institutional residence, this loss being more conspicuous for the feeble-minded institutions than for the others. In the institutions for dependents, the losses, while small, increased over a period of three and a half years. Over similar intervals, children in the feeble-minded institutions showed high cumulative losses. For children of the same initial IQ whose residence had been shifted, there was a tendency for the IQ on retest to follow the expectations in the new group: to lose in the feeble-minded institutions and to hold their own in the other institutions.

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[1] Crissey, Orlo L.: Mental Development as Related to Institutional Residence and Educational Achievement. *University of Iowa Studies in Child Welfare*, 1937, 13, No. 1, pp. 81.

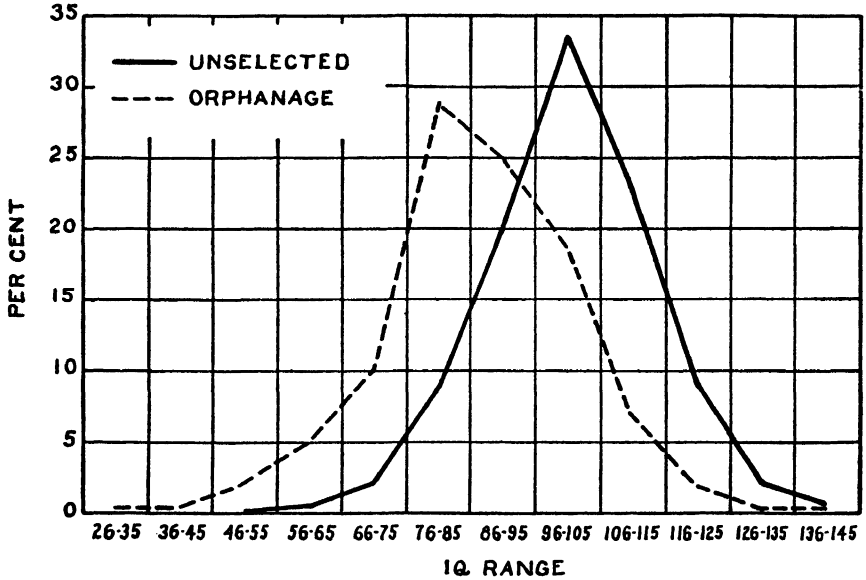

FIG. 35. IQ Distribution of Unselected Children and Orphanage Entrants, Ages Five to Fourteen Years. (From Skeels and Fillmore, p. 431.)

It is obvious that such findings cannot be applied to other institutions without a knowledge of the educational forces at work. There is no reason per se why an institution for the feeble-minded should not set up stimulatory conditions that would bring each child to his highest possible fulfillment. This presumably could be accomplished in a single institution, without transferring children whose advancing IQ merited a reclassification. However, for practical and social reasons, it is better to transfer all nonfeebleminded children out of institutions for the feeble-minded.

Skeels and Fillmore[1] surveyed the intelligence of 407 children admitted to an orphanage, ranging in age from one to fourteen years, whose intelligence tests had been given not later than a few weeks after entrance into the orphanage. Hence, the intelligence rating of these children was achieved under own-home conditions. The family backgrounds showed the general inferiority that characterizes such populations. The mean IQ of the children was 89. The IQ distribution for the children from five to fourteen years of age is illustrated in Figure 35. It was found also that the older children were inferior in IQ to the younger. This is illustrated in Figure 36. The tendency of this group to deteriorate was beyond the general expectation of lower IQ's for older children.

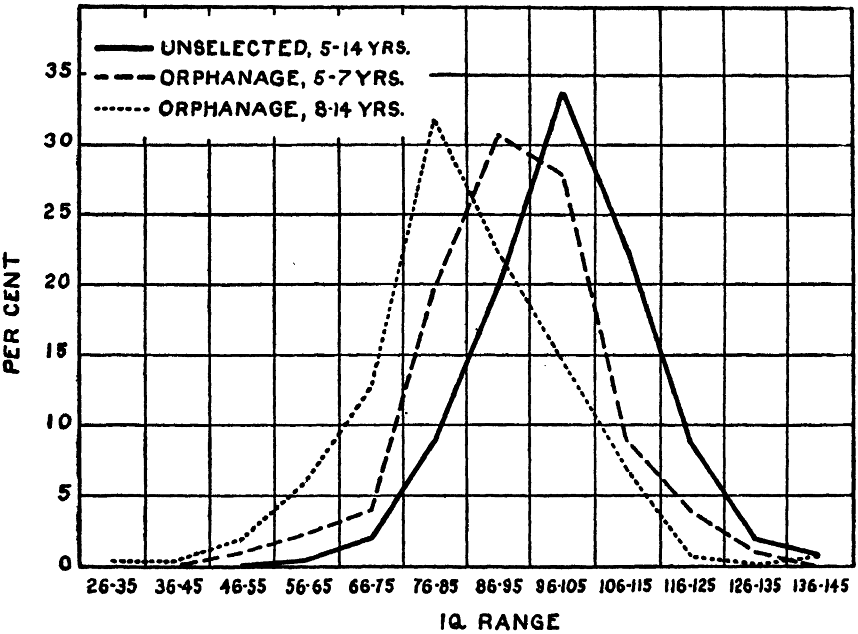

FIG. 36. Distribution of Unselected Children and Orphanage Entrants at Five to Seven Years of Age and at Eight to Fourteen Years of Age. (From Skeels and Fillmore, p. 432.)

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[1] Skeels, Harold M., and Fillmore, Eva A.: The Mental Development of Children from Underprivileged Homes. *Journal of Genetic Psychology*, 1937, 50, 427–439.

A CONTROLLED EXPERIMENT IN INSTITUTIONAL ENVIRONMENT

A major study by Skeels, Updegraff, Wellman, and Williams[1] is devoted to an attempt to check the impoverishing trend in a state orphanage by introducing a nursery school into the orphanage situation. This study was carried on at the Iowa Soldiers' Orphans' Home at Davenport. The sampling consisted of the entire preschool-age population which was divided into two matched groups of twenty-one children each at the start of the experiment. Utilizing the original criteria for matching, the experimenters added new children to both the control and the experimental groups during the three-year period of the study. Thus a total of fifty-nine different children was included within the preschool group, although the main research group consisted of thirty-five children who were enrolled for periods from one-half to two and a half years. The matching was based on chronological age, mental age, intelligence quotient, sex, nutritional status, and length of residence in the orphanage. The age range was from one and a half years to five and a half years. The mean age was forty-four months in each group, and the mean IQ's for the preschool and control groups were 82 and 81, respectively. These IQ's were based on Kuhlmann-Binet for children under four, and on Stanford-Binet for the older children.

The Davenport control group experienced the normal life of the orphanage, living in cottages and eating in a common dining hall; the experimental group lived under exactly the same conditions, except that it spent the day in the preschool. The following passage illustrates the general type of life experienced by these children:

> The preschool started at eight o'clock, the children being brought there in groups, by cottages, by some of the older school girls. More or less vigorous play, outdoors if possible, was usually planned at this time, followed by quieter activities, toilet, and finally, tomato juice and cod-liver oil at about 9:30. Thereafter came a rest period which was followed by activities of a constructive kind, musical experiences, stories, or an excursion. The children washed themselves at school in preparation for the noon meal and thereafter left for their cottages to go immediately to the main building

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[1] Skeels, Harold M., Updegraff, Ruth, Wellman, Beth L., and Williams, Harold M.: A Study of Environmental Stimulation: An Orphanage Preschool Project. *University of Iowa Studies in Child Welfare*, 1938, 15, No. 4, pp. 191.

> at noon. Naps in the cottages followed and school again about three, the children being brought as they woke from their naps. The afternoon always included experiences with books and music and, frequently, short excursions. Constructive play was also possible, as was motor activity. At five o'clock the children were called for and their supper came soon after, with an early bedtime. (p. 21.)

The nursery school had been designed by staff members of the Iowa Child Welfare Research Station; they continued its supervision throughout the experiment.

All the evidence indicates that the preschool environment provided was not the equal of the modern, progressive schools found in our research centers of child development or under the supervision of collegiate departments of education or home economics. None of the children had previously been in a nursery school, and there was a short attendance record for many. The attendance record of the children is classified below:

3 children attended the preschool	104 weeks or more
18 children attended the preschool	52 to 103 weeks
14 children attended the preschool	26 to 51 weeks
24 children attended the preschool	1 to 25 weeks

By the end of four months there was some deviation in the general IQ patterns. In the period of residence from 200 to 399 days, the preschool children gained 4 points in IQ, while the control group lost 1 point. For 400 or more days of residence, the preschool children gained 5 IQ points and the control group lost 5. For children under 80 IQ, preschool attendance did not make much difference. However, for those children whose IQ's were 80 or above, it was found that, with 400 days of residence, the preschool children maintained their status, while the control children lost 16 IQ points. A slight regressive tendency cannot explain the differential shift in the matched groups of children; the reliability of the tests was the same for both groups. Similarly, in vocabulary, general information, social competence, personal adjustment, and motor achievement, the experimental group tended to depart increasingly from the control, the departures being favorable to the preschool group.

The change in IQ's in relation to the number of days in residence for both the control and preschool groups is illustrated in Figure 37.

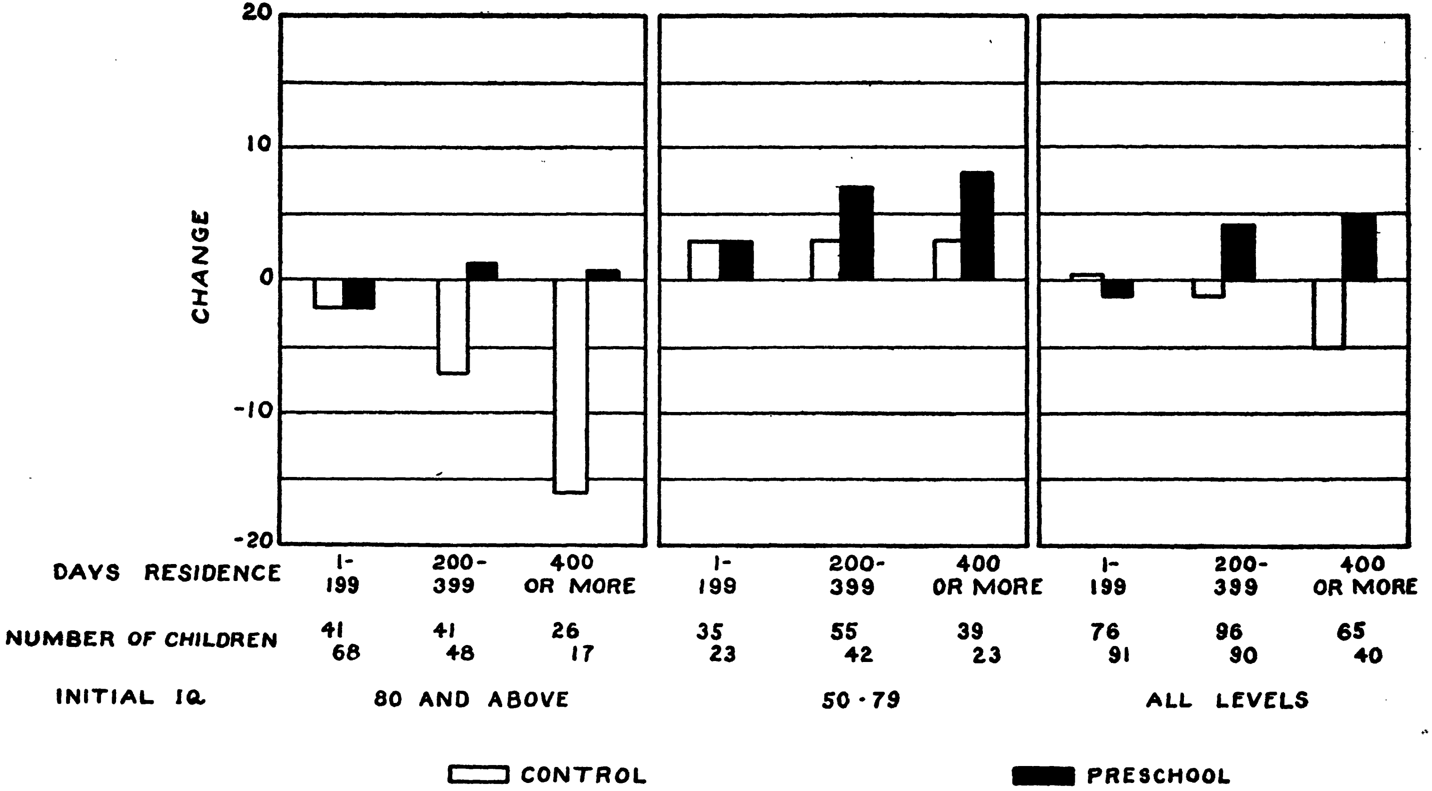

FIG. 37. Change in Binet IQ According to Days Residence between Tests. (From Skeels *et al.*, p. 38.)

Figure 38 shows the changes in Binet IQ with length of residence, by 10-point classifications for the initial IQ's.

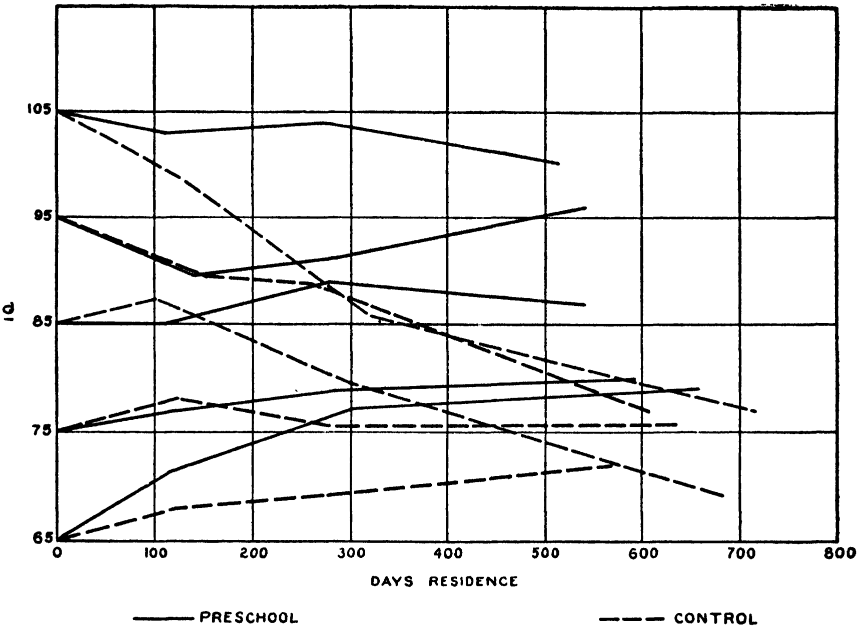

FIG. 38. Trend of Changes in Binet IQ with Residence: by 10-point Classifications. (From Skeels *et al.*, p. 40.)

Findings based on the Merrill-Palmer Scale were consistent with those from Binet testing, as is shown in Table 18 below:

TABLE 18[1]

COMPARISON OF MERRILL-PALMER IQ'S

	Number of Children	*Binet IQ at Entrance*	*Days Residence**	*Chronological Age, Months*	*Merrill-Palmer IQ*	*Standard Deviation*
Preschool .	23	79	311	45	93	13
Control . .	23	79	309	44	84	12

* Prior to Merrill-Palmer test.

The difference of 9 points between the preschool and control group is two and a half times its standard deviation. The control group of children, as measured by the Merrill-Palmer test, continued the downward grade with a period of residence up to nine hundred days, but the data for long residence are based on only a few children.

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[1] From Skeels *et al.*, p. 63.

On three occasions, the control and preschool groups were given the Little-Williams Language Achievement Scale. The scale covers speech sounds, intelligibility, and sentence organization. The only clear result from this testing is a tendency for both groups to decline in language quotient. It may be inferred that language stimulation in the orphanage, including the preschool as then organized, was unsatisfactory. In the Smith-Williams Vocabulary Test[1] which was administered to both groups eight months after the experiment began, and on three subsequent occasions, the preschool children were slightly higher than the control at practically all ages. The main finding consists of a significant departure of these children from expectation: Iowa City children, of the same mental ages, surpass both groups of orphanage subjects. This is brought out n Figure 39.

The Vineland Social Maturity Scale (see Part II) was given to both groups after the preschool had been running for eight months, and thereafter at six-months intervals. At every testing period there was a substantial superiority of the preschool over the control group. Of course, this scale is subjective and the difference should not be regarded as more than a trend. Williams, who administered the scale, corresponded with Doll regarding it in order to adhere closely to proper methods of observing and recording. The authors of the study make this interpretation:

> No doubt the great superiority of the preschool group may be accounted for in part by the fact of readiness to achieve coupled with opportunity hitherto lacking. Nevertheless it was shown that this superiority did not appear typically all at once in the sense of "can quickly learn to perform." On the evidence of the opinions of the preschool teachers it was achieved at the expense of a considerable amount of consistently directed effort on their part. After preschool experience, under a planful regime, therefore, the children were certainly functionally different in a socially significant way. (p. 144.)

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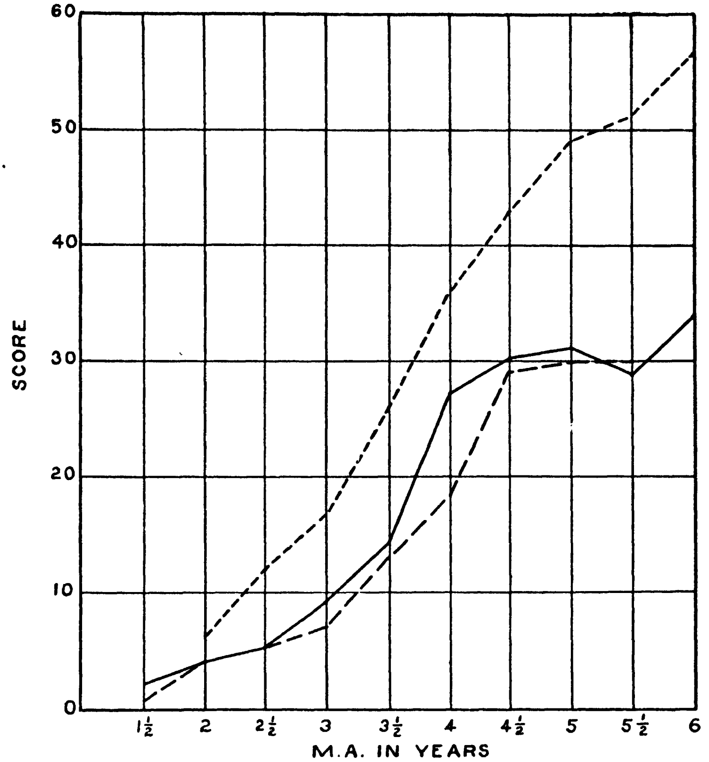
[1] Williams, Harold M., McFarland, Mary L., and Little, Marguerite: Development of Language and Vocabulary in Young Children. *University of Iowa Studies in Child Welfare*, 1937, 13, No. 2, pp. 94.

The preschool children showed improvement as measured by the Vineland scale; they also improved in social behavior as measured by the Berne Rating Scale.[1]



NUMBER OF CHILDREN

	1½	2	2½	3	3½	4	4½	5	5½	6
——— PRESCHOOL	3	8	12	8	10	14	5	9	8	1
— — CONTROL	1	13	16	7	13	12	6	11	1	
---- IOWA CITY		2	5	6	7	7	22	24	31	29

FIG. 39. Median Vocabulary Scores by Mental Ages. (From Skeels *et al.*, p. 94.)

Recently, Pegram[2] reevaluated the changes in these orphanage preschool and control groups, in terms of individual children. (In the original study, cases falling within designated age brackets had been utilized, thus permitting a child to enter more than once in either the control or preschool group.) Pegram's requirements covered these points: (*a*) attendance in the preschool six weeks or more for three or more days each week; (*b*) availability of two or more intelligence tests, one near the time of entrance to preschool, with a residence between initial and final test of one hundred days or more. For this comparison, forty preschool and forty-four control children were available. The mean initial IQ for the preschool subjects was 83, with a standard deviation of 12; for the control subjects it was 84, with a standard deviation of 14. Pegram's data on the relation between IQ and percentage of attendance, and IQ and length of residence in the preschool group, show that a high percentage of daily attendance in the preschool and a long period of attendance in the preschool were related to changes upward in mental ability. She carried through two analyses of covariance and arrived at these conclusions:

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[1] Berne, Esther Van Cleave: *Berne Rating Scale for Social Behavior of Young Children*. Revised by Harold M. Williams and Ruth Updegraff, November, 1934. Iowa Child Welfare Research Station, University of Iowa, Iowa City, Iowa. (Mimeographed.)

[2] Pegram, Edna Lee: *A Study of Environmental Stimulation Re-evaluated in Terms of Changes Made by Individuals*. University of Iowa, Unpublished Master's Thesis, 1940. Pp. iv, 37 ms.

> The control children who had been in residence 400 to 599 days and the preschool group of comparable residence were 4.9 IQ points apart in adjusted final mean in favor of the preschool children, and the control children who had been in residence over 600 days were 18.6 points lower than the preschool group with longest residence.
>
> The results which were obtained in the re-analysis were in general trend similar to those obtained in the original study. In some comparisons the gains of the preschool group and the losses of the control group were larger when re-evaluated in terms of individuals. (p. 29.)

It is to be hoped that a more comprehensive study similar to this one can be undertaken. In a larger study, these matters might well be considered:

(1) More children in both preschool and control groups.
(2) A preschool experience judged by experts to rank with the best that the country can now offer.
(3) A retention of children in the orphanage for the full length of the study, regardless of pressures for adoption.
(4) A means of preventing a cultural cross-fertilization from preschool to control group.
(5) Further intensive studies of various abilities of the children, as in language, vocabulary, motor ability, social competence, emotional behavior, and school achievement.
(6) Data on the abilities and achievements of parents in order to discover, as in the Skeels-Skodak materials (to be cited

presently), the departure of orphanage children from expectations based on family status; a follow-up of all the children through later institutional, boarding home, or foster care.

A study analogous to that outlined above could be carried on in any neighborhood that has a reasonable stability of population. In this case sociological data for the neighborhood would throw light on the uniformity of child experience outside the experimental and control situations. While an orphanage offers a better control over these outside experiences, it also sets limitations on the strength and comprehensiveness of the special factors that can be introduced for the experimental group. The idea of placing a really good preschool in an institutional environment leads to a revision of the whole orphanage plan. The good preschool, for example, calls for rich social experiences, as in group play, neighborhood contacts, and the utilization of facilities in communication, together with visits to stores, railways, airports, farms, factories, and museums. It calls moreover for a large amount of parent-child contact and for the education and guidance of the parents themselves. It can be seen that some of these requirements are incompatible with an institutional practice that restricts children in terms of adult contacts and social geography. It is unlikely that, for young children who are borderline, average, or above average in their first mental measurements, any *institutional* environment, however enriched, will provide the opportunities available in the best boarding or foster homes.

FOSTER CHILDREN

The Work of Skeels and Skodak

Skodak's study[1] carries further the work which Skeels had reported on the mental development of 73 foster children,[2] and later of 147 foster children,[3] his data having revealed highly satisfactory mental outcomes for children of inferior parentage who had been placed in good foster homes. Skodak's report is based on 154 children of whom all but 14 are illegitimate. As infants, most of these children had lived in hospitals or maternity homes, although a few had been in temporary boarding homes. All children were under six months of age at the time of placement, the mean age being 2.8 months, with a standard deviation of 1.7. At the time of the study, at least 90 per cent of the families had legally adopted the children, and this was the intention of all the families in the survey.

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[1] Skodak, Marie: Children in Foster Homes: A Study of Mental Development. *University of Iowa Studies in Child Welfare*, 1939, 16, No. 1, pp. 156.

[2] Skeels, Harold M.: Mental Development of Children in Foster Homes. *Journal of Genetic Psychology*, 1936, 49, 91–106.

[3] Skeels, Harold M.: Mental Development of Children in Foster Homes. *Journal of Consulting Psychology*, 1938, 2, 33–43.

Intelligence tests were available for 80 of the 154 mothers. On the basis of educational and economic background, these mothers may be considered representative of the whole sampling. The mean IQ was 88, with a standard deviation of 16 on the basis of the 1916 Stanford Revision. Skodak's tabulation indicates that 6 per cent of the mothers had IQ's above 110, while 54 per cent had IQ's below 90. Fourteen per cent of the mothers had IQ's under 70. Throughout the group, the social status of the mothers was inferior, as might be expected; many were well known to social agencies, and regarded as shiftless and irresponsible. Data on such items as relief, impoverishment, mental defect, institutional care, and arrests give the group as a whole a low standing.

The sampling of fathers is similar. Occupational data were available on 110 of the 154 fathers. The higher occupations were not so well represented in this group as in the general population. There was a pile-up in the lowest classification (day laborers); in the general population, about 20 per cent fall into this category, while the true fathers of these foster children showed 47 per cent. The mean occupational classification of fathers placed them within the slightly skilled and semiskilled categories. The fathers and their families, like the mothers of the children, showed a definite tendency toward dependency and social inadequacy.

The foster homes in which these children had been placed, while not confined to the higher occupational and social strata, showed a strong upward trend. For example, 14 per cent of the foster homes were in classification I (professional), and 23 per cent in classification II (semiprofessional and managerial). At the other end of the scale, it was found that only 1 per cent of the foster fathers were among the day laborers, and only 5 per cent in the slightly skilled. Each home was regarded by neighbors and experienced welfare workers as a good place in which to bring up a child. There is evidence that this satisfactory rating was secured in part by a selection of the better homes in any given occupational category.

The material that follows is cited directly from Skodak. Table 19 shows the distribution of intelligence quotients at two testing periods, the first period coming when the children had attained a mean age of two years, and the second when they had reached a mean age of four years and four months. At the time of the first testing, these children had lived with their foster parents nearly two years, and at the time of the second testing, four years, on the average. The IQ's in Table 19 are based on the Stanford and Kuhlmann revisions of the Binet-Simon Scale; the Kuhlmann, following the general practice, was used for the younger children.

TABLE 19[1]

THE IQ'S OF FOSTER CHILDREN

Intelligence Quotient	*First Test*	*Second Test*
155–159	0	0
150–154	1	0
145–149	0	2
140–144	5	1
135–139	7	5
130–134	10	9
125–129	23	9
120–124	19	12
115–119	21	14
110–114	21	35
105–109	15	20
100–104	10	22
95–99	13	8
90–94	4	10
85–89	2	6
80–84	3	1
79 and below	0	0
Number	154	154
Mean	116	112
S.D.	14	13
Median	117	111

Recently Skodak has applied a third testing to all available children. Comparative data for this sampling of 139 children in all three testing periods are given in Table 20; they are presented graphically in Figure 40.

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[1] From Skodak, p. 53.

TABLE 20[1]

IQ DISTRIBUTION FOR FOSTER CHILDREN IN CONTINUOUS STUDY

Intelligence Quotient	*First Test*	*Second Test*	*Third Test*
155–159	0	0	1
150–154	1	1	0
145–149	0	2	2
140–144	5	1	3
135–139	6	3	3
130–134	6	9	3
125–129	20	7	17
120–124	19	11	8
115–119	20	11	21
110–114	17	31	25
105–109	13	21	21
100–104	12	20	15
95–99	12	8	10
90–94	3	9	4
85–89	2	4	5
80–84	3	1	1
Number	139	139	139
Mean	116	112	113
S.D.	14	13	14
Median	116	111	112
Mean age	2 yrs., 3 mos.	4 yrs., 4 mos.	7 yrs., 1 mo.

It is clear that these foster children early reached a level above the general population, and that they have been able to retain a substantial superiority. It is to be noted too that very low IQ's have not cropped out and that, on the other hand, high IQ's are attainable. (For the first examination, the correlation between the IQ of the true mothers and the children was .06 ± .08; for the second examination, it was .24 ± .07.) Of course there never was any indication that these children were dull or feeble-minded. What has happened is that the general expectation of many psychologists and eugenists has not been fulfilled: dull parents have not produced dull offspring, but a population of children that maintains a high-average level.

These studies, and others like them, reveal the force of general environmental impacts on child populations. Children like these,

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[1] Data from Skodak in 1941.

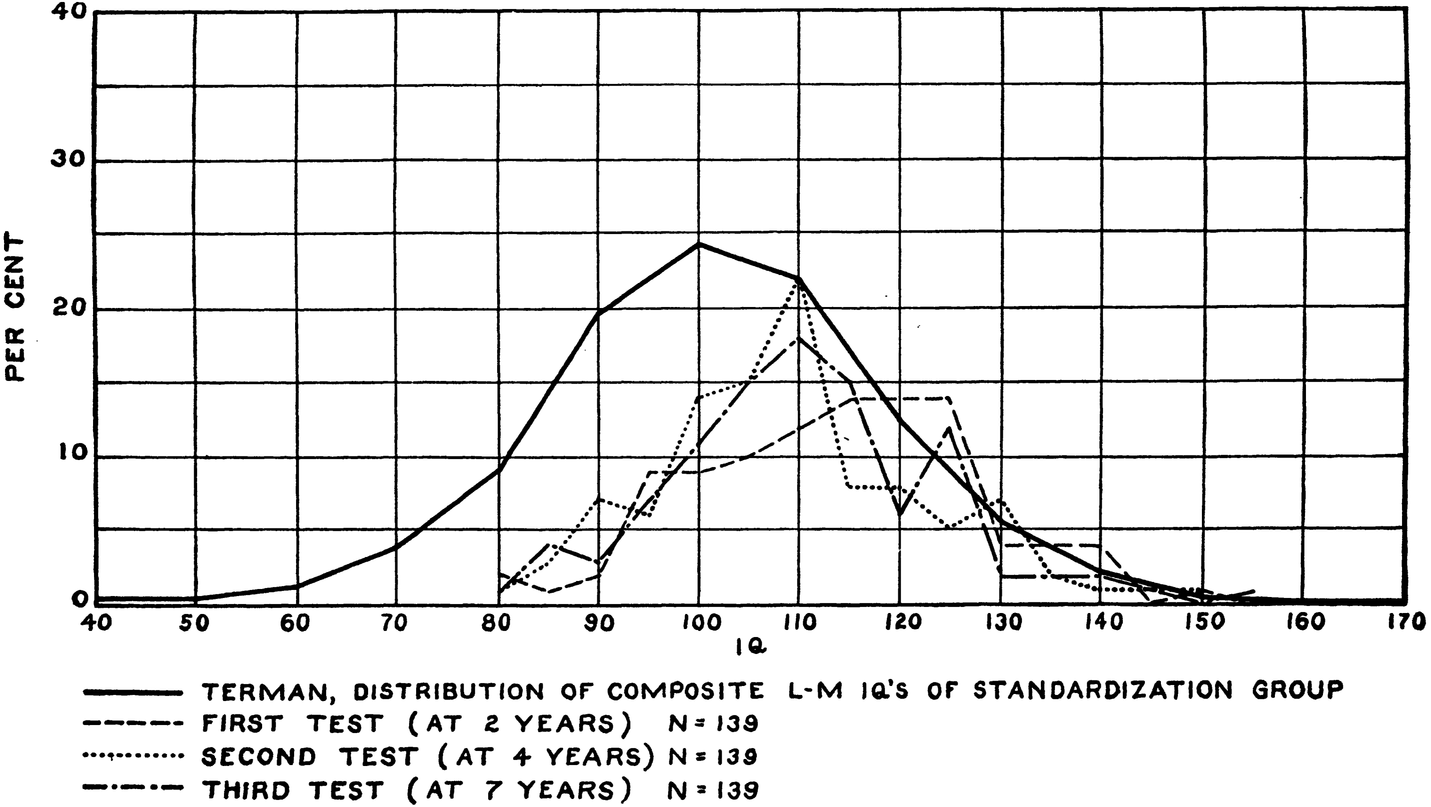

FIG. 40. Distribution of IQ's on First, Second, and Third Tests of 0 to 6-months Placement Group. (From data Supplied by Skodak in 1941.)

if left in their own homes (as is shown in the work of Speer), would, on the average, show a mental retardation. This has generally been ascribed to the *inheritance* of inferior organic mechanisms. Obviously the matter is not so simple as that. If the population described above can equal or exceed the general American norm for Binet IQ's, there is little basis for ascribing, on a priori grounds, a tissue inferiority to children whose parents are dull and impoverished, or even feeble-minded. This is not to say that parental feeble-mindedness would not produce a larger percentage of inferiority in the offspring. Fortunately extreme defect is related to biological sterility and to institutional commitment, such that true hereditary lines of feeble-mindedness among human beings are hard to establish. Where feeble-minded groups, like the classic Jukes and Kallikaks, have not been sterilized or committed, the general social outcomes, while frequently bad, are not directly ascribable to hereditary "taint": such people have traditionally lived under the most degrading social conditions. We simply do not know what would have happened to the children in such families if, at infancy, they had been allotted to good foster families. Certainly the most inferior portions of Skodak's groups would overlap the families of classic retardation.

A common error, which must be avoided in relation to the Skodak sampling above, is the statement that the good environment has increased the IQ's of the children involved. It will be noted that, on retesting, there has been a slight decline in the average intelligence of the children. *The important point is that these children, as a group, were never discovered to be anything but above average; at no time was their rating inferior.* The presumption from the observed and measured inferiority of parents to the expected inferiority of the child at birth is so strong that, when at two years or four years of age, a child is measured and found to be average, above average, or bright, we jump to the conclusion that an upward turn has taken place.

Skodak also had available a group of sixty-five children who had been placed in foster homes between the ages of two and five and a half years, having previously experienced the inferior environment of an orphanage. The majority of these children were legitimate; they came from homes broken by divorce, desertion, or institutionalization of a parent. Here again the true parents were inferior in every classification (70 per cent were day laborers), and the foster homes were well above the average. Binet testing before foster home placement yielded average IQ's of 97 and 99; after residence in the foster homes for a year and a half, the mean IQ was 104, and two years later it was 108. This part of Skodak's material should not be considered as more than suggestive, for there was a tendency for children to be placed on the basis of the child's initial IQ; that is, the children with higher IQ's were more likely to be placed with foster families in the higher occupational brackets. Nevertheless the test expectation for these children, if left in their own homes, would have been well below the attained average IQ of 108.

It should be pointed out that the Skodak findings are not a function of the suitability or unsuitability of tests for the early chronological years. It will be recalled that, in Part II of this volume, Binet testing was regarded as possibly more valid for the preschool ages than for later years. In any case, Skodak, in a follow-up study, reports a leveling off, for ages three to six, at IQ 111. There is fluctuation among the scores, but no consistent tendency toward increase or decrease for the sampling as a whole.

A correlation of .49 was obtained between the children's IQ's and measures of the foster home environment taken at the older preschool ages. The measure of environment was called "a home practice inventory." It covers play equipment, social contacts, language, behavior control, parental cultural interests, social participation, and physical equipment of the home. The items were rated on a five-point scale. While the scale may be regarded as only an approximation to an evaluation of parental practice, it is a step in the right direction. A further refinement should furnish clews as to what factors in the environment are operative in bringing children up to their mental potentialities. Table 21 indicates that the scale made a fairly consistent showing in relation to the different IQ levels.

In the Skodak study, a small amount of selective placement occurred as between the education of the true parents and that of the foster parents. The correlation was .30 ± .07. Whether or not this is sufficient to account for the tendency of children in the higher social brackets of the foster families to turn out better than those in the lower must be determined from further data.

TABLE 21[1]

RELATIONSHIP BETWEEN CHILD'S IQ AFTER RESIDENCE IN A FOSTER HOME AND SCORES ON AN ENVIRONMENTAL SCALE APPLIED TO THE FOSTER HOMES

Intelligence Quotient	*Home Inventory Score*									
	40 to 49	*50 to 59*	*60 to 69*	*70 to 79*	*80 to 89*	*90 to 99*	*100 to 109*	*110 to 119*	*Number*	*Mean Score*
140–149							3		3	105
130–139				3	3	2	3	2	13	93
120–129				1	5	5	3	1	15	93
110–119			2	5	8	7	8	1	31	90
100–109				9	10	5	2		26	85
90–99		2	2	4	1	1	1		11	75
80–89	1	1		1		1			4	67
Number . . .	1	3	4	23	27	21	20	4	103	
Mean IQ . .	87	90	102	109	113	113	121	127		

This slight selective factor has been reduced to zero in the recent Iowa placement procedure under the direction of Skeels.

Is there a possibility that the putative fathers were not correctly named by the mothers, or that their intelligence rating was superior to the mothers? Reviewing the total situation, we should say that it is unlikely that many errors were made in this respect. Any desire to prevaricate on the part of the mothers would lead them to name not an inferior person with small economic resources but someone a few cuts above this; financial expectation and pride of motherhood would pull in this direction. It is abundantly clear that the fathers were of the same social and economic stratum as the mothers. This leads to the expectation of a similar mental rating. (In a follow-up study of a small but representative sampling of these fathers, the average IQ was 85.)

In a further study, Skodak[2] drew from her group of 154 children 16 whose mothers were feeble-minded, the diagnosis being made on the basis of intelligence test scores, in conjunction with social data. The mean IQ of this group of mothers was 66, the range being from 54 to 74. The fathers of the children here involved showed a heavier emphasis upon the lower two occupational classes than was true of the total population of fathers, 80 per cent being in the two lowest categories. As Skodak says:

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[1] From Skodak, p. 73.

[2] Skodak, Marie: The Mental Development of Adopted Children Whose True Mothers Are Feeble-Minded. *Child Development*, 1938, 9, 303–308.

> Thus there is a group of sixteen children, whose true-family history is extremely poor, who have at least one parent known to be feeble-minded, but who were placed at a very early age in foster homes above the average of the general population from the standpoint of occupation and social status. It is possible to compare the mental development of these children with that of a larger group of adopted children whose true-family history, while inferior to that of a population as a whole, is not as extreme in its deviation. Both groups of children have experienced essentially only the environment of the adoptive homes, and the foster homes of the children of known mentally defective mothers do not differ significantly from those of the group as a whole. (p. 305.)

In the first examination, corresponding to the first examination for all the foster children, these sixteen children of feeble-minded mothers showed an average IQ of 116, and on the second examination an average of 108. In other words, they were the same as the whole group on the first examination and not significantly inferior to them on the second. There is some evidence that children of these feeble-minded mothers, if placed in the best foster homes (as judged by occupational classification), would depart significantly from those placed in the lowest foster homes, similarly rated. For such a small group of children, this tendency must be considered only suggestive.

Van Steenberg's Report

In 1939, the Carnegie Foundation, on the recommendation of Frederick Osborn, granted a postdoctoral fellowship to Neil J. Van Steenberg for the purpose of studying the genetics of intelligence as revealed in the Iowa materials. After spending a year in this work Van Steenberg wrote as follows (letter to H. M. Skeels, dated November 7, 1940):

> In Dr. Skodak's study the descriptions of the true mothers were terse and objective and I should say she probably erred on the side of brevity and did not augment her descriptions with all the information that could have been obtained for fear the taint of subjectivity might encroach upon her report. This is the procedure normally used in scientific work and is normally a laudable and

adequate method but since, in this case, the validity of the objective findings has been challenged, one can but regret that she was not more picturesque in her descriptions even at the cost of some precision. I have found upon examination of the material on which her report was based that the general tenor of her report does not even come near a true description of the lower levels of social strata from which these people, the true mothers and true fathers, were drawn. I was astonished that living conditions in a rural and rather prosperous state like Iowa could reach such a low level.

The school records obtained by the true mothers of the children in question have been taken by some as an indication of a higher intellectual level than the one reflected by intelligence tests. I have found that in Iowa as in a number of other states the modern educational policy in most places is to promote a child regularly regardless of attainments, at least up to a certain limit. With the shift in educational policy from one in which the teacher has to defend the attainment by the child of skills and knowledge as a basis of promotion to one where the lack of promotion is a subject of reports and much justification, has come a condition where mere school attendance is generally sufficient to attain a certain grade and hence grade attainment tends to be a meaningless term.

On the trip which I made to a number of counties in the State of Iowa, I interviewed a number of these true mothers. I made a subjective evaluation of their living conditions and also obtained information about them from relatives and neighbors, etc. A wide range of living conditions was encountered. A few were living what appeared to be lower middle class lives, married to some kind of mechanic, truck driver, or someone in a like vocation, whose houses were reasonably clean and well kept and who now had legitimate children who showed signs of maternal care. But these cases were widely at variance with the average conditions encountered. In most cases these women were found "down by and on the wrong side of the railroad tracks" and in the most dilapidated houses on the least desirable block in town. My recollections are generally of filth, squalor and pitiable living conditions — a complete abandonment of any attempt to attain normal social status or a lack of understanding of the discrepancies between the way they lived and the way they might live even under relief status. In so far as the present living conditions of these women reflect their earlier lives and in so far as they reflect their intelligence, the description of the true mothers should be revised downward in a social and intellectual scale rather than upward.

In her study Dr. Skodak obtained a slight correlation between the intelligence of offspring and true mothers. To what extent this correlation is due to a selection of better foster homes for children with the better social history and to what extent it might be due to actual inheritance cannot even be guessed at this time. Even if later studies should reveal that there is some correspondence between chromosomal inheritance and intelligence, as that term is now generally interpreted — that is, a social concept — the error of prediction in any individual case would be so large as to make such prediction useless.

Further Questions

Van Steenberg's reference is to the unexpectedly high level of school attainment reported for the true parents in Skodak's study: a mean of tenth grade for both fathers and mothers. That this rather even school promotion was commonplace in some states that were relatively homogeneous as to type of school or community life was known to various observers. Ayer[1] stated in 1936: "In recent years there has been a tendency to favor 100 per cent promotion through the elementary grades." Similarly, in 1934, Brueckner[2] had said: "The tendency appears to be to promote on an age basis, so that pupils may be kept fairly homogeneous according to their chronological age and social group. No longer are pupils required to repeat a grade because of failure to meet more or less arbitrary standards of achievement." Certainly in Iowa, law, habit, and neighborhood expectation all work in the same direction. Recently R. H. Ojemann, in following up the cases occurring in an early survey conducted by the Iowa Child Welfare Research Station,[3] reports the mean grades completed (in four communities): for men, 12, 13, 12, and 10; for women, 13, 12, 12, and 12. These communities were all rural, the mean IQ of the cases in the last one listed above being only 92 and 95, for men and women, respectively. Moreover, a grade *reported* as "completed" has been found by Irene E. Harms to be approximately one grade above the verified scholastic facts. Perhaps the only way to equate differentials in state attendance laws, school standards, and regional tradition is to utilize "grade-equivalents" from the normative tables of comprehensive batteries of achievement tests.

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[1] Ayer, Fred C.: School Progress. *Review of Educational Research*, 1936, 6, 164–168.

[2] Brueckner, L. J.: The Cumulative Effects of a Policy of Non-Failing. *Journal of Educational Research*, 1934–1935, 28, 289–290.

[3] Baldwin, Bird T., Fillmore, Eva Abigail, and Hadley, Lora: *Farm Children: An Investigation of Rural Child Life in Selected Areas of Iowa.* New York: D. Appleton-Century Company, Inc., 1930. Pp. xxii, 337.

With respect to the substantial sampling of Iowa foster children, Skeels has located all the available babies over a five-year period. To quote:[1]

> From this number several deductions are necessary. Nine babies were colored children and for the purpose of this study have been excluded. Thirty-five children were not subject to adoption because commitment prohibited placement in foster homes. Of this number, 31 were returned to the homes of relatives and 4 were transferred to other agencies. Since this study is not concerned with the mental development of children in their own homes, these have been excluded. Twenty-one babies died in early infancy. Six additional children were unplaceable because of physical or physiological defects (one born blind, one a mongol, one with birth injury, one with congenital heart defect, one without hands, and one with general physiological defect).
>
> After these eliminations there remained 319 babies, of which 308, or 96.6 percent, have been placed in adoptive homes. Consequently, only eleven children, or 3.4 percent of the 319 children available for adoption, have not been placed. Unplaced children include 4 withheld from placement because of unusually poor family histories, 2 luetic children, 2 with chronic ear difficulty, 1 with chronic upper respiratory infection, and 2 for reasons not classified.
>
> Of the 308 babies committed under six months and placed, 224 were placed before, and 84 after, the age of six months. A number of children were near 6 months of age at the time of commitment and of necessity could not be placed until after reaching 6 months of age because of the time required for medical examinations, observation, and assignment to the adoptive homes. Still others required temporary medical care and more prolonged observation before placement could be consummated. (pp. 301–302.)

Harms' Work

In a further study of the mental development of Iowa children in foster homes, Harms[2] devoted her analyses to a group of children, all with inferior social histories, who had been placed in adoptive homes in infancy. On the basis of institutional records, these children were divided into three groups as follows:

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[1] Skeels, Harold M.: Some Iowa Studies of the Mental Growth of Children in Relation to Differentials of the Environment: A Summary. The Thirty-Ninth Yearbook of the National Society for the Study of Education. *Intelligence: Its Nature and Nurture.* Part II. *Original Studies and Experiments.* Bloomington, Ill.: Public School Publishing Company, 1940. Pp. xviii, 409. (pp. 281–308.)

[2] Harms, Irene E.: *Children with Inferior Social Histories: Their Mental Development in Adoptive Homes.* University of Iowa, Unpublished Master's Thesis, 1941, pp. iii, 114 ms.

Group I. Children whose mothers were mentally retarded, as indicated by an intelligence quotient of 75 or less.

Group II. Children whose true fathers were inferior in occupational status, falling into categories "unskilled" or "slightly skilled" laborers.

Group III. A small group of children for whom the mother and the father fell into the respective classifications above.

These children had been committed to a state orphanage when less than six months of age, and placed in adoptive homes when under two years of age. Over an eight-year period, 107 children fell in Group I, 131 in Group II, and 35 in Group III. Of all the children studied, a large majority were illegitimate, and the others also came from homes showing bad social and economic conditions. Intelligence quotients based on the 1916 Stanford Revision were available for the true mothers; they were obtained by psychologists in a university hospital. Tests given the children included the 1922 Kuhlmann Revision, the 1916 Stanford Revision, and the 1937 Stanford-Binet. The Kuhlmann tests were given children under three and a half years of age, and the Stanford beyond that age.

In Group I (defective mothers), the IQ's of the mothers ranged downward to 32, and the mean was 63, with a standard deviation of 9. The educational, social, and economic conditions were consistent with these ratings. The occupational status was available for 53 of the fathers; about 70 per cent were in the unskilled and slightly skilled laboring class. While the foster parents represented a selection upward on all social criteria, the ratings would not be so high as for the foster homes in the Skodak study. (Nineteen of Harms' children appeared also in the Skodak study.)

At the close of the study, intelligence test data were available for 87 of the 107 children. These children were tested in the foster homes at a mean age of five years and five months. This means that they had experienced no significant contact with their true-family environment, having spent, on the average, five years in the foster homes. Examination of the records of the true mothers indicates that no selection took place at this time; if anything, the untested group was slightly superior to those tested. (For example, the mean true-mother IQ for the tested group of children was 63, and for the untested group, 74.) The mean intelligence quotient for 87 children in foster homes was 106, with a standard deviation of 17. The range in IQ was from 55 to 141. Only four children classified below the dull-normal, while fifteen were superior. The distribution is given in Table 22.

TABLE 22[1]

DISTRIBUTION OF INTELLIGENCE QUOTIENTS FOR FOSTER CHILDREN WHOSE TRUE MOTHERS HAD AN AVERAGE IQ OF 63

IQ	*Name of Test*			*Total*
	1922 Kuhlmann	*1916 Stanford*	*1937 Stanford*	
Above 130	1	1	1	3
126–130	1	3	1	5
121–125	4	1	2	7
116–120	4	4	2	10
111–115	5	8	2	15
106–110	6	3	1	10
101–105	2	2	2	6
96–100	1	2	3	6
91–95	2	3	1	6
86–90	4	5	2	11
81–85	0	1	3	4
Below 81	2	0	2	4
Total	32	33	22	87
Mean	106	107	102	106
S.D.	18	13	18	17
Median	109	108	103	108

The intelligence of these foster children bore no significant relation either to that of their true mothers or their foster mothers, the coefficients being respectively .23 and .12. As in the Skodak study, when foster homes were divided into upper and lower levels on the basis of a general quality rating, there was a slight IQ difference in favor of the children residing in the upper group, but the difference was not statistically significant. There was no tendency for the better foster homes to draw children from the upper levels of the population of retarded mothers.

Harms carried out a similar analysis of the mental development of children whose fathers had a low occupational status. These children also had been placed in a foster home at a mean age of five months. All the children were legally adopted by these foster parents or were considered as permanent additions to the family.

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[1] From Harms, p. 47.

All the true fathers were in the two lowest work classifications, and 80 per cent were in the lowest (unskilled labor category). Other social data were consistent with this status. For eighty-nine mothers of the children, Stanford-Binet IQ's were available. The mean was 78 and the range was from 40 to 113. The foster homes were superior. The distribution of the children's IQ's is given in Table 23. It will be seen that the mean IQ is above that of the general population, with only two children below the dull normal level, while twenty-eight children had IQ's above 120.

TABLE 23[1]

DISTRIBUTION OF INTELLIGENCE QUOTIENTS FOR FOSTER CHILDREN WHOSE TRUE FATHERS WERE IN THE TWO LOWEST OCCUPATIONAL CATEGORIES

IQ	*Name of Test*			*Total*
	1922 Kuhlmann	*1916 Stanford*	*1937 Stanford*	
Above 140	2	0	1	3
136–140	2	0	0	2
131–135	2	0	1	3
126–130	5	4	1	10
121–125	5	3	2	10
116–120	5	7	1	13
111–115	4	8	1	13
106–110	6	8	2	16
101–105	5	4	1	10
96–100	5	5	5	15
91–95	2	2	1	5
86–90	0	4	3	7
81–85	0	1	1	2
Below 80	2	0	0	2
Total	45	46	20	111
Mean	113	108	108	110
S.D.	17	12	18	16
Median	114	109	103	110

In this section of the study it is not possible entirely to rule out selective factors at the various true mother and foster home levels. Children of mothers testing above 80 IQ when placed in the best foster homes achieved an average IQ of 119; when placed in the poorest foster homes, the average reached was 110. The main trend, however, is clear: these children of the most lowly occupied fathers, whose mothers also were centered in the dull-normal classification, come out significantly above average under foster home conditions.

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[1] From Harms, p. 73.

The third Harms group involved children whose mothers were mentally deficient and whose fathers were in the lowest occupations. Thirty-five children were available at the start of the study, and thirty-one were tested at its close. They were placed in the foster homes at a mean age of four and a half months. As in the other groups, the children were permanently placed in these foster homes, all with the expectation of adoption. The mean IQ for the mothers was 63, with a standard deviation of 9. The social and cultural status of both true parents was markedly inferior, while the foster homes again were above average. In this group, as in the others, the percentage of farm families is higher than would be found in general population statistics. The distribution of IQ's of the foster children is given in Table 24. The correlation

TABLE 24[1]

DISTRIBUTION OF INTELLIGENCE QUOTIENTS FOR FOSTER CHILDREN WHOSE TRUE MOTHERS HAD AN AVERAGE IQ OF 63 AND WHOSE TRUE FATHERS WERE IN THE TWO LOWEST OCCUPATIONAL CATEGORIES

IQ	*Name of Test*			*Total*
	1922 Kuhlmann	*1916 Stanford*	*1937 Stanford*	
126–130	0	2	1	3
121–125	2	0	1	3
116–120	2	1	0	3
111–115	2	1	1	4
106–110	1	2	0	3
101–105	0	1	0	1
96–100	1	2	2	5
91–95	1	1	0	2
86–90	0	3	2	5
81–85	0	0	1	1
Below 80	1	0	0	1
Total	10	13	8	31
Mean	106	103	103	104
S.D.	20	12	16	16
Median	114	101	100	104

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[1] From Harms, p. 95.

between the intelligence of the children and of the true mothers is .12. There is a tendency, not significant for this small sampling, for children in the better foster homes to show higher IQ's, although the selective factor as between true parents and foster parents is probably negligible.

OTHER STUDIES OF PLACEMENT AND ADOPTION

A research project on the influence of environment on the course of mental growth, if carried out according to scientific procedures and with substantial results, stands by itself. It follows from such work that environment can have an effect. If the results from one group or a single institution are verified by results obtained elsewhere, then the general validity of the concepts rises. As pointed out in the Thirty-Ninth Yearbook:[1]

> The Skeels-Skodak data, especially, afford a good touchstone of the comparability of other data and studies over the country. Before anyone asserts that similar results have not been found elsewhere, he should ask of the investigator whose work may have been of a comparable sort these questions:
>
> 1. Were the children taken from their true mothers in infancy; that is, in the first few months of life?
> 2. Were they placed, not in institutions or boarding homes, nor in unselected foster homes, but in socially selected foster homes *for adoption?*
> 3. Were the children followed for as long as 4 or 5 years?
> 4. Were individual Binet's used for all tests?
> 5. Was the sampling substantial, say at least 50 cases?
> 6. Was reliable case information available on the mothers and fathers, as a check upon the results of adult mental testing?
> 7. Were any eliminations from the sampling strictly medical or legal in character; and were all eliminations accounted for?
>
> One may turn the main question the other way around: What investigators, whose data are consistent with the implications of the 7 questions, have reported anything incompatible with the Skeels-Skodak findings? (p. 427.)

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[1] Stoddard, George D., and Wellman, Beth L.: Environment and the IQ. The Thirty-Ninth Yearbook of the National Society for the Study of Education. *Intelligence: Its Nature and Nurture.* Part I. *Comparative and Critical Exposition.* Bloomington, Ill.: Public School Publishing Company, 1940. Pp. xviii, 471. (pp. 405–442.)

Snygg's Findings

Snygg[1] reports for 312 children who were placed in foster homes, for the most part during infancy, a correlation of .13 ± .04 between the true mothers' IQ and the children's IQ. These data are based on Kuhlmann tests for children under three and on Stanford-Binets for the older children. As Snygg says, ". . . there is little possibility of predicting the IQ of any child from the IQ of its mother, although mothers with IQ's under 70 did have the largest percentage of dull and subnormal children." (p. 403.) That the negligible correlation between mother and child is not a straight-line affair is shown by the fact that the highest IQ's were obtained by the children of 77 mothers whose own IQ's were between 70 and 79. This small group of mothers "produced 17 children with IQ's over 109, as many as all the 235 other mothers combined. Even the mothers with IQ's under 70 produced as high a percentage of bright children as did the mothers with IQ's of 90 or higher." (p. 404.) (The average IQ for the whole group of mothers was 78.) Since the correlations between true mother and foster child did not increase for groups of children ranging from one year to five years of age, and since the case histories of the fathers indicated that their mental status was similar to that of the mothers, Snygg concluded that a knowledge of the mental status of the true parents was of no practical use in predicting the mental development of foster children. These findings, like those of Skeels and Skodak, have obvious implications for social workers and child placement agencies.

The Work of Speer and Bender

Speer's recently published work on foster children[2] is consistent with the findings of Skeels and Skodak. His work was based on underprivileged children who had been declared dependent by a juvenile court and placed in selected foster homes. The age of placement was determined by the need of the child for parental supervision: "When the parents died, deserted, or were declared incompetent, all the children under 16 years were declared dependent." (p. 50.) Such homes were of low socioeconomic level, with a high frequency of parental instability, alcoholism, and delinquency. Extreme poverty was the general rule, and mental defect was common. Speer gives a vivid description of the degradation children suffered in their homes:

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[1] Snygg, Donald: The Relation Between the Intelligence of Mothers and of Their Children Living in Foster Homes. *Journal of Genetic Psychology*, 1938, 52, 401–406.

[2] Speer, George S.: The Intelligence of Foster Children. *Journal of Genetic Psychology*, 1940, 57, 49–55.

> A random sampling of 15 true homes shows extreme poverty in every case; eight of the parents are mentally defective, as well as a number of the collateral relatives; eight were sexually degenerate and four were known to be venereally diseased; in three instances, the father had had incestuous relations with his daughters; six of the parents were insane and in state hospitals and, in addition, at least two of the immediate relatives were also insane; four of the parents were alcoholic; four were dead; three had deserted their families. (p. 50.)

One hundred eighty-four children were studied; mothers of 68 of these were mentally defective, showing a median IQ of 49 — all in state institutions. The fifty-seven additional mothers were apparently normal, but not examined, and fifty-nine children were included in the study without regard to the mental status of parents. For the feeble-minded and normal mothers, Speer reports the following data:

TABLE 25[1]

CHILDREN OF FEEBLE-MINDED AND NORMAL MOTHERS

Number of Years' Residence in Own Home	*Children of Feeble-minded Mothers*		*Children of Normal Mothers*	
	Number of Children	*Median IQ*	*Number of Children*	*Median IQ*
0–2	12	101	15	100
3–5	19	84	29	91
6–8	12	75	36	91
9–11	9	72	22	92
12–15	16	53	14	81
Total	68		116	

Here we have a decline in median IQ in relation to the number of years spent under the conditions described above. The downward trend for the children of normal mothers is much less marked; it is more of a mental deprivation for children to live with inferior parents than with normal parents. (Heredity does not change from age to age.) Of the children above, fifty-nine were examined after placement in the foster homes. They showed a median IQ of 103 for those placed before the age of three and of 79 for those placed after twelve. The foster homes were regarded as superior. To quote Speer:

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[1] After Speer, p. 51.

> . . . If intelligence can be developed or improved by stimulating environmental situations, as Wellman suggests, we believe that it should occur in this situation, after placement in this superior environment. And, as measured by the Binet IQ, it does. . . . The data indicate that the IQ of the child is directly affected by environmental conditions; it is depressed by inferior or limited environmental stimulation, and increases when the child is placed in a superior environment. (pp. 52, 54.)

Speer raises a question which is of interest not only in the placing of foster children, but in studies of the effects of nursery-school attendance or of other enriched social and educational environments; namely, what is the relationship between the length of exposure to the new environment and the amount of change experienced by the child? While most correlations thus far reported are low or negligible, we should not assume that the environment has therefore been ineffective. In taking a given amount of a drug there could be a small correlation between the period of consumption and the effects produced, or such a correlation might be negative. When it is negative, we say that a tolerance has developed such that even more of the drug (or other factor) must be introduced in order to achieve a given effect.

In environmental effects what we have is a change in status related to the length of the experience and to its quality and intensiveness. An adolescent may listen to a lecturer whose effect upon him is to change his life career or guiding principles; this does not mean that listening to an additional lecture on the same subject would do much more, or if differently oriented, change the person back to his original state. We cannot get anywhere through gross relationships based on time alone; such correlations, whatever their size, may be meaningless. The environmental stimulation in the best of homes may be a complex mixture of plus and minus impacts. Nobody would say that the longer a person stayed in sixth grade the more he would know, for such correlations tend to be negative. Only if the opportunities offered through the practices of parents, teachers, and associates are constantly, or at least generally, in an upswinging pattern, can we expect accelerations to be maintained. Bender,[1] at the conclusion of a study of sixty children who had been brought to the observation ward of a psychopathic hospital, was strongly impressed with the parental influence upon child behavior and adjustment. She also observed: "Mental and emotional retardation occurs in children who are confined with defective or schizophrenic parents, and are deprived of the normal environmental stimuli for growth, especially language development, in the early years." (p. 336.) A collation of test materials and case histories in children's wards and clinics would serve to make more lifelike the actual circumstances, pressures, and deprivations that lead to the kind of deterioration reported by Speer and others.

Stippich's Report

Stippich[2] studied the mental development of seventy-seven children who were divided into an experimental and control group. The former consisted of forty-eight children whose mothers were mentally retarded (median IQ in the low 60's), the latter of twenty-nine children of normal mothers with a median IQ of 102, and a range in IQ from 87 to 175. Practically all the children were illegitimate. In the experimental group they were wards of the state, and in the control group they were under the guardianship and support of their mothers. Both groups were placed early in boarding homes, orphanages, hospital nurseries, and schools for the feeble-minded. While the boarding homes were of the same general character for both the experimental and control group, it is clear that the institutional placements for the experimental group were inferior to those of the control group. The children in both groups led hectic lives, there being no less than 130 homes and 20 institutions for the experimental group of 48, and 61 home and 13 institutional placements for the control group of 29. After one year of such experience, the average IQ from the combined results of Kuhlmann-Binet and Stanford-Binet was 83 for the experimental group and 97 for the control. Later tests indicated an increase in IQ for both groups, but without changing the advantage of the control group. All the children of the control group gained on retest after two years, while two-thirds of the experimental group made gains. It is to be noted that some of these children have been kept in inferior institutional and boarding home situations for as long as thirteen years. This leads to the question as to whether, over the years, there is not some selective factor taking place. *Under what conditions do neglected, illegitimate children in Minnesota stay on a temporary and admittedly stressful basis for so many years?* Obviously any tendency to rescue children whose mothers were normal and able to pay for their support would give a relatively unfavorable weight to the children of feeble-minded mothers. The relation between this study and the work of Skeels and Skodak I have pointed out elsewhere:[1]

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[1] Bender, Lauretta: Behavior Problems in the Children of Psychotic and Criminal Parents. *Genetic Psychology Monographs*, 1937, 19, 229–339.

[2] Stippich, Mary Elizabeth: The Mental Development of Children of Feeble-Minded Mothers: A Preliminary Report. The Thirty-Ninth Yearbook of the National Society for the Study of Education. *Intelligence: Its Nature and Nurture.* Part II. *Original Studies and Experiments.* Bloomington, Ill.: Public School Publishing Company, 1940. Pp. xviii, 409. (pp. 337–350.)

> It should be noted that this study is not directly comparable with the studies of Skeels and Skodak. Stippich does not present data indicating the mental growth of children of feebleminded mothers placed in boarding homes of superior occupational level. If these children, too, should turn out to be below average (as does her whole experimental group), the findings will be considered somewhat inconsistent with the Iowa studies. ,But the two sets of studies would not be contradictory, for the Iowa work is based entirely on the placement of children *for adoption in selected foster homes.*
>
> In essence, Stippich reports in this preliminary study that, under equal conditions of stimulation, in institutions and commercial boarding homes, the children of normal mothers will test about average, while those of feebleminded mothers will be dull-normal (central tendencies). For the illegitimate children of normal mothers it will be helpful to have a further checking of the sampling and of the conditions incident to financial support, guardianship, selection of boarding home, and school facilities.

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[1] Stoddard, George D.: Personal Reactions of the Yearbook Committee. The Thirty-Ninth Yearbook of the National Society for the Study of Education. *Intelligence: Its Nature and Nurture.* Part I. *Comparative and Critical Exposition.* Bloomington, Ill.: Public School Publishing Company, 1940. Pp. xviii, 471 (pp. 456–459.)

> If, in the full sampling to be made available in a further study by Stippich, these results are borne out, it is possible that both Stippich and Skodak will be right. In short, under certain conditions the children of feebleminded mothers may achieve normality (Skodak); and under other conditions, subnormality (Stippich). (p. 458.)

The Work of Hildreth and Wells-Arthur

Hildreth's study[1] does not show a significant superiority on the part of a group of fifty-four foster children who had been adopted by selected foster parents and sent to a superior school. The average IQ was 103. Her sampling happens to contain one feeble-minded child in the bracket 60–65 (with no entries between IQ 65 and 80), and no IQ's above 135. The main restriction on Hildreth's findings, however, is implied in this statement: "Foster parents have in some cases sought out this superior school with the intention of offsetting the relatively slow development the adopted child was exhibiting in adjustment and learning." (p. 182.) In short, some of the children, as measured by tests or school achievement, were already showing deterioration; this school was looked upon as a therapeutic device. Such a factor operating in a small sampling makes it difficult to arrive at valid conclusions.

The results of Wells and Arthur,[2] while consistent with those of Skeels and Skodak, are not along exactly the same lines. While they use the term *foster home*, it is clear that the children studied were not placed for adoption. They analyzed two groups of one hundred children each, for whom one or both parents were feebleminded. One group of children stayed in their own homes, the other was placed in "foster" or boarding homes. Each group had had a Binet test at or near the beginning of the period under consideration, and again not less than two years later. Kuhlmann- and Stanford-Binets were utilized, although one retest was based on Kuhlmann-Anderson. At the time of the first test the home-residence group averaged six years and seven months in age and the boarding-child group five years and six months; the average IQ's were, respectively, 81 and 80. On reexamination, at an average chronological age of twelve years for the own-home children and ten years and five months for the boarding-home children, the average IQ of the first group had dropped 7 points and that of the second group had increased 1 point. Wells and Arthur break up the sampling by 10-point IQ classifications on the first test. In no classification did the own-home children improve in IQ, the changes running from zero for those under 75, to −17 for those 95 or over; for the boarding children there was a gain of 11 points for those under 75 and a loss of 14 points for those above 95. Since regression effects would be the same in both distributions, the boarding home children were probably turning out a little better. There were other differentials with respect to age:

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[1] Hildreth, Gertrude: Adopted Children in a Private School. The Thirty-Ninth Yearbook of the National Society for the Study of Education. *Intelligence: Its Nature and Nurture.* Part II. *Original Studies and Experiments.* Bloomington, Ill.: Public School Publishing Company, 1940. Pp. xviii, 409. (pp. 179–184.)

[2] Wells, J., and Arthur, G.: Effect of Foster-Home Placement on the Intelligence Ratings of Children of Feebleminded Parents. *Mental Hygiene*, N. Y., 1939, 23, 277–285.

> For 38 of the foster-child group who were placed in foster homes before they reached a chronological age of five years, there was a median gain in IQ of 8.16 points. . . . For the 62 who were placed in foster homes when they were five years of age or older, there was a median loss in IQ of 4.5 points. (p. 283.)

Leahy's Report

Leahy[1] compared two groups of children living in "approximately identical environments." One group consisted of adopted children, the other of own-children. All the adopted children were illegitimate; this group, called the experimental group, consisted of the records on children between the ages of five and fourteen. All the adopted children were placed at the age of six months or earlier, the mean age being two and a half months. No farm children were included, and over 95 per cent of the group were reared in cities. Each adopted child was matched with an own-child on the basis of sex, age, occupational status of the father, parental education, race, and size of town. The children were tested by the 1916 Stanford Revision, and the adults by the Otis Self-Administering Test of Mental Ability. For the 194 children in each group, the mean age was slightly over nine years. The average IQ of the adopted children was 111, and the own-children, 110. The mean school-grade attainment, Otis score, and occupational status were about the same for the adoptive and own-child parents. The environmental status score for the adoptive homes was rated as somewhat superior to that for the own-child homes.

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[1] Leahy, Alice M.: Nature-Nurture and Intelligence. *Genetic Psychology Monographs*, 1935, 17, No. 4, 235–308.

Such items as Otis score of the parent and Stanford-Binet vocabulary of the parent correlated in the .50's with the IQ's of own-children, while the correlations for the adopted children were in the low .20's. While these differences may be significant, it is necessary to recall their unimportance in terms of a total control over the factors involved. Above an *r* of .90, a difference of a few points in the coefficient may be meaningful; for low correlations, the coefficient of alienation is extremely high. Thus a correlation of .20 is only a 2 per cent improvement over guessing, while a correlation of .50 is a 13 per cent improvement; in either case most of the variability as between mid-parent and child is unaccounted for.

A puzzling part of Leahy's observations in this connection lies in her expectation that there should be a *correlation* between the IQ of an adopted child and the abilities of foster parents. Theoretically what can happen is somewhat different. Intelligent parents who provide superior facilities and home practices should bring out the full potentialities of the child. If all children were of equal mental potentiality, we should expect a substantial relationship between the ability of the foster parents and the developing ability of the child. But all children are not the same at birth or at any time thereafter: whenever measured by whatever tests, they show a wide distribution of ability. Moreover, there is no one-to-one relationship between the intelligence of parents and success in providing appropriate stimulatory conditions for the child.

Another puzzling thing about Leahy's results is that the correlation between child IQ and mid-parent mental ability is of the same order as that between child IQ and these factors: cultural index of the home, child-training index of the home, sociality of the home, mid-parent education, and father's occupational status. Are all these gene-controlled? Is it to be assumed that these correlations depend entirely on the further relation between parental intelligence and environmental factors? How can one account for the fact that *all* groups of adopted children in the

Leahy study are superior, even when found in the homes of slightly skilled and unskilled day laborers?

What we need for the children in Leahy's study, as in so many others, is a measure of what can happen to children in any given category at a designated age under specified circumstances — under what conditions do they move downward or upward, and what are the limits when environmental factors are applied to the fullest? It is conceivable, for example, that average or below-average parents, utilizing good techniques and offering experiences that are enriching at the lower mental ages, can surpass the influence of more able persons who neglect children.

If, in genetic constitution, parent-child resemblances in mentality, as in physique, are not to get above $r^2 = .25$, the area open for a benevolent influence on mental development is indeed encouraging. Presumably *everything* can be accounted for by heredity and environment, provided all the factors in the theoretical dichotomy are available for measurement. Yet in the Leahy study "heredity" and "environment," taken together, accounted for less than 30 per cent. It is easy to slip into the error of assuming that the variance unaccounted for should be placed on the side of heredity. For complex measures like intelligence or behavior, no such assumption should be made. (We cannot reasonably assume that even standing height is a 100 per cent outcome of hereditary factors.) In the Twenty-Seventh Yearbook of the National Society for the Study of Education, it was the dependence on a correlational *analogy* as between physical and mental traits, together with an assumption that the residual variance was essentially hereditary (this concept itself resting upon the alleged constancy of the IQ), that made the estimate of the relative contributions of heredity and environment confusing and untrustworthy.

AN EXPERIMENT IN STIMULATION

Recently, Dawe[1] has reported an improvement in the language ability of children in the Davenport orphanage, in relation to an intensive educational program. This program emphasized the understanding and use of language symbols. It involved training in the understanding of words and concepts, looking at books and pictures, listening to poems and stories, and going on short excursions. A large classified list of words and pictures served as a starting point for the intensive training of the children, the idea being to make all the concepts employed concrete and meaningful. Control and experimental groups, consisting of eleven pairs of children, were obtained from the preschool and kindergarten groups of the orphanage. Matching was based on school groups, sex, chronological age, mental age, IQ (on Form L of the Stanford-Binet), and the score in the Smith-Williams Vocabulary Test. (Children of appropriate age in the orphanage now go to the preschool or kindergarten.) The training period ran for a total of 92 days and was conducted chiefly on week-ends. Each child received, on the average, 50 hours of special training. A comparison of the experimental and control groups at the end of the study revealed that the experimental group made a gain of 14 IQ points, while the control group lost 2 points. The final mean IQ for the experimental group was 95, and for the control group, 80. As might be expected, the experimental group also made a significant gain in vocabulary. On Form M of the Stanford-Binet, which does not include a vocabulary test, the experimental group at the end of the training had a mean IQ of 95, and the control group a mean of 85. This difference also was significant. It should be borne in mind that there was no training in regard to actual testing materials, nor in anything directly related to them. The whole study was set up on the simple basis that orphanage children lack a give-and-take informational contact between child and adult. The purpose of the experiment was to overcome, to a slight degree, this rather general defect. Nothing that these children experienced would approach the ordinary conversational experiences of children living in average or above-average multiple-child families.

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[1] Dawe, Helen Cleveland: *A Study of the Effect of an Educational Program upon Language Development and Related Mental Functions in Young Children.* University of Iowa, Unpublished Doctoral Dissertation, 1940, pp. viii, 295 ms.

SKEELS-DYE

That under special conditions young children who had been rated as feeble-minded or dull can show a remarkable upturn is illustrated in a small sampling studied by Skeels and Dye.[1] A group of thirteen children, ranging in age from seven to thirty-six months, with a mean of nineteen months, obtained Kuhlmann-Binet IQ's ranging from 35 to 89, with a mean of 64. These children were transferred from the impoverished orphanage situation previously described to the care of girls, who were chronologically and mentally older, in the wards of a feeble-minded institution. In spite of the mental defect of these older girls, they had sufficient advantage over the younger children to offer them considerable guidance, affection, and recreational experience. They enjoyed spending time with "their babies," talking with them, securing toys and play materials and taking them on walks, supervised excursions, and car rides. In fact, the newcomers were taken to school as soon as they could walk, the youngest ones remaining for half the morning, and those of four or five years of age attending the kindergarten throughout the day. After a period of residence that ran from six months to fifty-two months for the various children, all the changes in IQ were found to be substantially upward.

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[1] Skeels, Harold M., and Dye, Harold B.: A Study of the Effects of Differential Stimulation on Mentally Retarded Children. *Proceedings of the American Association for Mental Deficiency*, 1939, 44, 114–136.

Needless to say, this rapid upturn in IQ does not establish a general rate of acceleration to be maintained. These children did not finally reach the average for children in an unselected population (the mean for the last test was 92). The increase may be regarded rather as a function of the sudden change from an environmental stimulation that was well below par to an affectionate, attention-giving experience. Since all testing was done under expert and standardized conditions, it is necessary, in any theory, to allow for radical shifts in Binet IQ's. The intelligence quotient, even if it were based on satisfactory materials, would be subject to especially wide variations when applied to young children.

HOLLOW FOLK

Sherman and Key,[1] in a study of isolated mountain groups, found a relationship between ratings of community isolation and the intelligence scores obtained on various tests. There was moreover a strong tendency for the scores to drop as the children grew older. The study is based on a small number of cases and should not be regarded as more than suggestive; it will not really be completed until a survey following improvements in educational and social opportunities has presented new data for comparative purposes. That the environment of the school-age child in these "hollows" furnished very little of the abstract and linguistic is clear enough.

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[1] Sherman, Mandel, and Kev, Cora B.: The Intelligence of Isolated Mountain Children. *Child Development*, 1932, 3, 279–290.

It cannot be assumed that the mere fact of staying on and submitting to impoverishment is in itself a measure of mental inferiority. What we have is a vicious circle. By the time a new generation has been subjected to bad conditions for fifteen years it has probably deteriorated with respect to energy, mentality, and social ambition. Van Steenberg's description of conditions to be found in a rich, fertile, literate state like Iowa, yielding in one generation mental dullness, immorality, and social inadequacy, is equally depressing. Nevertheless, in the next generation, as Skeels has shown, we find mental and social superiority, with no change at all in genetic lines. Under radically improved cultural conditions this upturn could take place in Virginia, even though a given adult generation of "hollow folk" were rated as deficient, slack, and satisfied.

WHATEVER IS, IS MEASURED

Both the initial intelligence and the later intelligence of children are as real as any other measurements of intellectual status. The concept of intelligence and of intelligence testing simply refers to delivered products whose development and utilization within the individual are conditioned by appropriate environmental opportunity. As far as can be ascertained (the evidence is meagre on either side of the question), intelligence scores that are compounded out of a long period of impoverishment followed by a short period of intensive stimulation are as representative of the child's total ability as scores derived from steady but unanalyzed "normal" environmental processes. The "normal environment" for the child in an orphanage or an underprivileged home is one of impoverishment: the IQ's decrease. Under happier circumstances, IQ's measured in exactly the same fashion tend to increase. May not the search for constancy, invariance, and determinism — for an all-potent unitary control, long abandoned by anatomists and biologists in regard to structures and patterns that are relatively stable — be relinquished with respect to acquisitions like vocabulary, reading comprehension, and general information?

EFFECTS OF NURSERY SCHOOL EXPERIENCE

Turning to children in the higher economic brackets, we find considerable evidence that children experiencing the advantages of a preschool, or its equivalent, will show an upward shift in intelligence quotient.

Wellman's Report

The principal data in this connection have been accumulated by Wellman and her associates at the Iowa Child Welfare Research Station. They have been recapitulated by Wellman[1] for the Thirty-Ninth Yearbook. Of the 808 children enrolled for at least one regular academic year in the preschool laboratories of the Station, 652 were available for a study of the changes in IQ during preschool attendance. They had been given Stanford-Binet or Kuhlmann-Binet tests early in the fall and late in the spring under good conditions of rapport. The children were highly selected on a socioeconomic basis, for 73 per cent of the fathers and 53 per cent of the mothers had experienced from sixteen to twenty years of schooling. The mean initial IQ for the 652 children was 117; the average gain during a year of preschool attendance was 7 points. The distribution of these changes, as compiled by Wellman, is given in the table on the next page.

There is a tendency for IQ gains to be cumulative for two years of preschool attendance. Complete records were available for 228 children on a two-year basis, and for 67 children for three years of attendance. For the 228 children, the average IQ gain during the first year was 7 points, as in the complete sample, and for the second year, an additional 4 points. However, there was a fractional point loss over the summer period of nonattendance, leaving the net gain at 10 points for the two-year period. Sixty-seven children, over the three-year period, gained an average of 8 points during the first year of attendance, an additional

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[1] Wellman, Beth L.: Iowa Studies on the Effects of Schooling. The Thirty-Ninth Yearbook of the National Society for the Study of Education. *Intelligence: Its Nature and Nurture.* Part II. *Original Studies and Experiments.* Bloomington, Ill.: Public School Publishing Company, 1940. Pp. xviii, 409. (pp. 377–399.)

4 points in the second year, and 2 more points in the third year; there was a loss of 3 points over the two summer sessions, leaving a net change of 11 points.

Points of Change	*Number of Children*
+ 43 – + 47	1
+ 38 – + 42	1
+ 33 – + 37	9
+ 28 – + 32	19
+ 23 – + 27	24
+ 18 – + 22	55
+ 13 – + 17	72
+ 8 – + 12	108
+ 3 – + 7	124
– 2 – + 2	113
– 3 – – 7	69
– 8 – – 12	31
– 13 – – 17	12
– 18 – – 22	6
– 23 – – 27	7
– 28 – – 32	0
– 33 – – 37	1
Total	652

A further tabulation of intelligence records in the Station shows that for twenty-nine children who had been enrolled for four years in the preschools, the average initial IQ was 116, and the average final IQ, 127, or a gain of 11 points. In this tabulation there is considerable leeway in both the spring and fall testing: the fall tests were given between September 1 and December 1, and the spring tests between March 1 and June 15. As a result, in this four-year attendance group, the average chronological interval was only three years and six months.

A new report of the Iowa preschool children on whom we have complete data over a two-year record of preschool attendance brings out certain points:

1. Even among selected children under relatively homogeneous conditions of home life and general culture, there is a wide shifting in IQ.
2. Under these conditions the possibilities include:
   (*a*) a marked gain for many children, (*b*) an insignificant gain or loss for many children, (*c*) a marked loss for some children.

These Iowa figures indicate that the preschool influence is realized in the early years of attendance. (There is no guarantee that all groups of children, superior at the beginning, will show a significant upturn in a preschool.) We may postulate that, for bright children, only a very rich environment can be effective in mental acceleration. In theory, the brightest preschool children in a group already highly selected need special tuitional and stimulatory conditions adjusted to their mental potentiality.

In this connection, a minor experiment of McCandless[1] is of interest. He matched two groups of six four-year-old children with respect to chronological age and IQ. All the children were above IQ 124. In his experimental setup he devoted much personal attention to the children, setting up projects of observation, planning, and child participation that would make demands upon the originality of the group. After a half-year on these special projects, the children in the experimental group were somewhat above the control group in IQ.

Wellman[2] has shown that the high mean IQ ratings achieved by preschool children are not artifacts associated with the type of test employed, nor meaningless in relation to further mental ratings in elementary school, high school, and college. However, the prediction of an individual mental rating in high school or college from IQ's obtained in the preschool years, whether accelerated or not by enriched school and home experience, is hazardous.

Retesting will show that any IQ obtained at any age may (*a*) remain constant; (*b*) move steadily upward; (*c*) move steadily downward; or (*d*) fluctuate. *The IQ derived from a single mental testing gives no clew whatever as to the course of future events.* To undertake predictions it is necessary to (*a*) repeat the mental testing at intervals, (*b*) secure comparative data on school performance, (*c*) assemble all data of a physiological, motor, and medical nature, and (*d*) analyze the dynamics of home, school, and community environment.

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[1] McCandless, Boyd Rowden: *The Effect of Enriched Educational Experiences upon the Growth of Intelligence of Very Superior Children.* University of Iowa, Unpublished Master's Thesis, 1938, pp. ii, 127 ms.

[2] Wellman, Beth L.: Mental Growth from Preschool to College. *Journal of Experimental Education,* 1937–1938, 6, 127–138.

The Merrill-Palmer Report

The second largest study of nursery-school children in the Thirty-Ninth Yearbook utilized 103 children at the Merrill-Palmer School. For this group, Starkweather and Roberts[1] report an average IQ gain of 6 points after a year's attendance in the nursery school.

The Minnesota Report

The only other large sampling was reported at the University of Minnesota,[2] where, for eighty-four cases attending one year, the average gain was 5 IQ points; for fifty-one cases with two years' attendance, the average gain was 6 points, and for thirteen cases with three years' attendance, the gain was 6 points. These gains were not significantly different from those achieved by matched children of preschool age who did not attend the nursery school. For one reason or another, from an original sampling of 147 nursery-school children and 269 nonnursery-school, there were eliminated, during the course of the study, no less than 134 of the nursery-school children and 245 of the nonnursery-school children!

Further doubt is cast upon the Minnesota study because of the likelihood of selective factors in both the experimental (nursery-school) and control groups. To quote Goodenough and Maurer: "Transfer to the kindergarten is made automatically at the age of five, and children of advanced physical and mental development are often promoted to the kindergarten at an even earlier age." This process, perhaps defensible from an educational standpoint, would operate to drain off the *fastest growing children.* But, in the control group, in which the families were highly selected on a socioeconomic basis, there was a tendency to eliminate children who were *backward:*

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[1] Starkweather, Elizabeth K., and Roberts, Katherine E.: IQ Changes Occurring During Nursery-School Attendance at the Merrill-Palmer School. The Thirty-Ninth Yearbook of the National Society for the Study of Education. *Intelligence: Its Nature and Nurture.* Part II. *Original Studies and Experiments.* Bloomington, Ill.: Public School Publishing Company, 1940. Pp. xviii, 409. (pp. 315–335.)

[2] Goodenough, Florence L., and Maurer, Katharine M.: The Mental Development of Nursery-School Children Compared with That of Non-Nursery-School Children. The Thirty-Ninth Yearbook of the National Society for the Study of Education. *Intelligence: Its Nature and Nurture.* Part II. *Original Studies and Experiments.* Bloomington, Ill.: Public School Publishing Company, 1940. Pp. xviii, 409. (pp. 161–178.)

> . . . the obtained intelligence quotients of groups thus selected will also tend to increase with age, owing to the inclusion of a greater proportion of cases whose IQ's are rising; that is, approaching more nearly to the level of their (superior) parents. A comparison of nursery-school and control groups with respect to the two conditions mentioned indicates that selective elimination of cases from the study on the basis of parental intelligence is almost certainly present in the control group. (p. 175.)

TABLE 26 [1]

DISTRIBUTION OF PERCENTILES IN MERRILL–PALMER TEST SCALE FOR NURSERY-SCHOOL AND WAITING-LIST CHILDREN

Percentiles	*Merrill-Palmer Nursery School*		*Merrill-Palmer Waiting List*	
	Boys	*Girls*	*Boys*	*Girls*
0– 4	1	2	2	1
5– 9	—	—	4	1
10–14	1	1	1	4
15–19	—	—	2	2
20–24	2	—	3	7
25–29	3	1	8	7
30–34	3	3	8	5
35–39	2	1	3	3
40–44	3	3	4	4
45–49	2	4	10	8
50–54	—	4	4	11
55–59	2	2	4	3
60–64	7	1	5	2
65–69	6	4	5	5
70–74	5	3	4	8
75–79	11	8	7	3
80–84	4	9	7	4
85–89	2	1	4	6
90–94	7	2	3	7
95–99	11	10	5	5
Total	72	59	93	96
Median percentile . .	74	75	52	53
Sexes combined, Total .	131		189	
Median percentile . . .	75		53	

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[1] From Stutsman, p. 119.

Results on the Merrill-Palmer Scale

There are a few studies of the possible effects of nursery-school education that utilize other than Binet tests. One of the most substantial of these is reported by Stutsman[1] who confirmed Woolley's earlier finding that the nursery school was favorable to mental development. Stutsman's data are given in Table 26. The social composition of the two sets of families was the same.

Black's Findings

Black's data,[2] based on twenty-seven children at the Harriet Johnson Nursery School in New York, are consistent with Wellman's. On the new Stanford-Binet, the children obtained a mean IQ of 122 in the fall and 128 in the spring. On the Merrill-Palmer test, the mean increase was from 117 to 134. Black concludes:

> The new Stanford-Binet is highly stable and reliable for a preschool test. Even over a period of change, such as entry into nursery school, it shows a high correlation on retests (.80) and when this factor of changing status is eliminated by giving the first test *after* nursery school experience, the correlation rises to .94, which compares favorably with reliabilities in school-age children.
>
> The Stanford-Binet appears to be less affected by nursery school than the Merrill-Palmer and to be affected in a more uniform manner. (pp. 163–164.)

The Work of Messenger

Messenger[3] recently has made an intensive study of nursery-school and nonnursery-school children in Iowa City and Stillwater, Oklahoma. Altogether she had about one hundred children available in the two situations. The study was carried on over a two-year period, with some interim measurements at the end of the first year. Many of the control children were on a nursery-school waiting list; as a group they were comparable to the children entering nursery school, and their families were of the same socioeconomic status. The groups under comparison were fairly stable in both situations. In Iowa City, 20 out of 25 nursery-school and 22 of 27 nonnursery-school children remained in the study for a two-year period; in Stillwater, 16 of the 26 nursery-school and 17 of the 27 nonnursery-school children were available for the two-year period. At the beginning of the study, in the fall of 1937, IQ's for the Iowa City nursery-school children ranged from 100 to 148, with a mean of 119; for the nonnursery-school children, the range was from 100 to 154, with a mean of 116. In the initial testing at Stillwater, the nursery-school children ranged in IQ from 95 to 154, with a mean of 122; the nonnursery-school children ranged from IQ 97 to 142, with a mean of 118. These slight differences in initial ability were taken into account in the method of covariance which was employed in analyzing the data. Children under three and a half years of age were given the Kuhlmann revision, and those above this age, the original Stanford Revision. The Stanford Revision was the final test used in all cases. All tests were given by experienced persons.

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[1] Stutsman, Rachel: *Mental Measurement of Preschool Children: With a Guide for the Administration of the Merrill-Palmer Scale of Mental Tests.* Yonkers-on-Hudson, N. Y.: World Book Company, 1931. Pp. x, 368.

[2] Black, Irma Simonton: The Use of the Stanford-Binet (1937 Revision) in a Group of Nursery School Children. *Child Development,* 1939, 10, 157–171.

[3] Messenger, Virginia M.: *A Longitudinal Comparative Study of Nursery School and Non-Nursery School Children.* University of Iowa, Unpublished Doctor's Dissertation, 1940. Pp. viii, 270 ms.

The essential data reported by Messenger are contained in Table 27.

It will be noted from this table that at the end of the first year of nursery-school experience there was a gain of 10 points in the Iowa City situation, and of 7 points in Stillwater. During the second year, the nursery-school children failed to add to their gains. At the end of the second year, the gain was 8 points in Iowa City; in Stillwater, the total two-year gain was 3 points. The entire picture for the nonnursery-school group is a maintenance of the initial IQ status. The final differences between the nursery-school children and nonnursery-school children, both at Iowa City and Stillwater, are significant at the 1 per cent level of confidence.

To conclude that only the child's first year in a nursery school may have measurable effects upon his mental rating would be erroneous, for the "first year in this study was really the second year of nursery school experience for many of the children involved." No child was ruled out for whom there was a likelihood of a two-year attendance period following the initial testing program. Eight nursery-school children in Iowa City and seventeen in Stillwater had previously attended the nursery school, the experience running from a summer session to a full year. These eight Iowa City children had already gained 8 points in the nursery

TABLE 27[1]

INTELLIGENCE TEST GROUPS: MEANS AND STANDARD DEVIATIONS FOR AGE AND INTELLIGENCE OVER ONE- AND TWO-YEAR PERIODS

Groups	*Iowa City Nursery School*		*Iowa City Nonnursery School*		*Stillwater Nursery School*		*Stillwater Nonnursery School*	
	Mean	*S.D.*	*Mean*	*S.D.*	*Mean*	*S.D.*	*Mean*	*S.D.*
	1937–1938							
	N = 23		N = 26		N = 25		N = 23	
Initial chronological age	38	6	36	7	38	7	35	8
Final chronological age	45	6	43	6	45	7	41	8
Initial IQ . .	120	13	117	12	122	13	119	11
Final IQ . .	130	12	119	12	129	15	118	14
	1938–1939 *							
	N = 19		N = 22		N = 16		N = 16	
Initial chronological age	46	6	43	6	46	6	40	7
Final chronological age	58	6	55	7	57	6	52	7
Initial IQ . .	131	11	117	12	132	14	120	15
Final IQ . .	130	11	115	12	130	9	120	11
	1937–1939 *							
	N = 20		N = 22		N = 16		N = 17	
Initial chronological age	39	5	36	7	39	6	33	7
Final chronological age	58	6	55	7	57	6	51	7
Initial IQ . .	122	13	118	13	127	13	120	11
Final IQ . .	130	11	115	12	130	9	121	11

* Two children in the two-year group (one in the Iowa City Nursery-school Group and one in the Stillwater Nonnursery-school Group) did not receive intelligence tests in 1938. This accounts for the discrepancy in numbers for the 1938–1939 and the 1937–1939 groups.

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[1] From Messenger, pp. 91–92.

school by the time they were included in this study; the mean gain, which for them was 7 points, produced a total gain of 15 points over a two-year period. In Stillwater, the trend was similar: the seventeen nursery-school children with previous experience in the nursery school had already gained 6 points, and they gained an additional 6 points during the first year in this study.

Nevertheless, in the Messenger study, as in others, there is not a picture of cumulative gain from one year of preschool to the next, nor the establishment of a relationship between length of attendance and amount of gain. At present, neither the clock nor the calendar gives a good indication of what is happening in the stimulation of children. In the long run, given the isolation of important factors in a nursery-school program, together with a hierarchical offering suitable for advancing levels of talent, such a relationship would develop. We should not expect *all* the environmental influences to be unloaded within a day, a week, or a month, however dramatic might be the first upturn. Once the effective procedures (which will vary for different levels of child ability) are known, we can expect a convergence in terms of (*a*) the intensity of the factors, (*b*) the number of factors, (*c*) a pattern of reenforcement and hierarchy among factors, and (*d*) the length of time given over to environmental impingements. Analogously effects equally deleterious could be produced by radical deprivation for short periods of time or mild impoverishment long sustained. Even in situations where organic growth and environmental factors related to it are well established, it is difficult to secure high correlations. Were we to take the test-scores representing influences upon an organism, as in nutrition, exercise, sleep, drugs, and infections, we should not, over a given segment of time, expect substantial correlations with measures of growth, health, or physical fitness. In each continuum above, as in environment-as-related-to-intelligence, the interplay of cause and effect is complex.

POINTS OF AGREEMENT

On the whole, the Iowa findings are not out of line with those from other institutions. As I have pointed out previously,[1] practically all groups of children in preschool tend to gain in IQ, although for small samplings the trend may not be significant. In the Iowa City samplings, these trends were upward over a two-year period and were associated with attendance in the nursery school. In some situations elsewhere, the matching of equally bright children in selected families showed a similar upward trend for both preschool and nonpreschool children.

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[1] Stoddard, George D.: Intellectual Development of the Child: An Answer to the Critics of the Iowa Studies. *School and Society*, 1940, 51, 529–536.

A valid criticism of all studies is that at no ages, preschool or beyond, do the tests as a whole give genuine scope to the range of talent found among selected children. Really to know what has been accomplished, and could be accomplished, through the enrichment of child life will call for more than simple subtractions of one IQ from another. It is reasonable to utilize the very fact of increase in IQ's of the type visualized in Part II of this volume as a major criterion for environmental excellence. This, of course, is standard practice in medical and scholastic situations. If the operation is performed and the patient improves, the operation is considered successful (the case in which the patient dies after a "successful" operation can be regarded as special!). In schoolwork, in order to avoid a circularity of argument, independent or semi-independent examinations are set up which, if mastered under specified conditions, tend to validate the teaching procedures.

While it is unlikely that any variance emanating from hereditary sources, as revealed in studies of genealogy, could emerge independently of environmental factors, this is different from saying that hereditary predispositions and limiting factors have not already been incorporated in the criteria — *the organism can only be what it could have become.* The true significance of environmental studies lies in revealing that the acceleration achieved by educational enrichment, whether or not it lifts the IQ, is more than a hothouse phenomenon. It is neither superficial glibness, nor a familiarity with test fragments that is being built into the tissues and behavior patterns of these children; it is a sound and persistent connection between the child and objects, places, persons, problems, and relationships.

The preschool child, for example, is treated as a person capable of thought who demands exercise and achievement in the abstract — as a part of the spinning out of his natural endowment. Placed in a dreary cocoon of life, without much guidance at home, a life that, for millions of children from two to five years of age, is characterized by negation and restriction, the child fails to grow satisfactorily; from the standpoint of mental and social experience, he endures a season of undernourishment. If, in the middle of the twentieth century, the million most underprivileged American four-year-olds could speak with the resounding voice of organized capital, labor, or religion, something and somebody would have to give!

It can be predicted with some confidence that when homes and schools give the child what he truly needs, at all ages from the first year upward, there will be a radical revision in the norms and standards for mental tests. But this is a minor consideration. More important to the welfare of children, and of the nation as a whole, is the idea that we must develop the unused reservoirs of mental power. The process will take courage. An abler and better informed youth population will demand changes in home, school, and community practice that transcend our traditional concepts of the young in society. Eventually such a program, if developed into a movement with social, economic, and political implementation, will lead to a way of life so truly democratic and American in its ideology as to frighten all but the firm believers.

PART V
INTELLIGENCE AND SOCIETY

CHAPTER XV

EDUCATIONAL IMPLICATIONS

EXPECTATIONS FOR THE NORMAL CHILD

The most characteristic thing about a child is that he grows; he keeps changing into something else. I have referred to so many limitations in the concept of mental age that it seems gratuitous to add another. It must be clear to everyone that the process of averaging mental-age increments irons out many individual differences in the scholastic aptitudes of pupils. A child who tends to come to a full stop at his basal mental age is somewhat different from one whose abilities are widely scattered, permitting him, along certain lines, to get beyond the general expectations for a school grade. Many studies have shown a tremendous range of talent within a typical school grade, whether the tests be labeled intelligence, aptitude, skill, readiness, or achievement. There is no fundamental equivalence, even if the children are grouped homogeneously in terms of similar scores on composite tests. If it were possible to classify students in September, in terms of mental and scholastic traits, we could be sure that substantial differences would arise in June.

Regardless of class size and the breadth of the curriculum, the elementary-school teacher is inevitably placed in a tutorial position. If she attempts to work down from vague generalizations on pupil ability and interest, she is certain to overemphasize whatever commonality exists: children are so plastic and suggestible as to be singularly vulnerable to Procrustean methods. The reverse procedure, while avoiding this danger, need not be carried to an extreme that would involve an undue dependence of the child upon the teacher. If classes were much smaller than they now are, it is unlikely that provision could be made in the schoolroom for the intimacy of child-adult contact commonly found in the average or above-average home. We are not sure that an extreme tutorial plan is indicated for any level of school instruction from nursery school to college. Lacking satisfactory evidence, we may mention certain considerations that are borne out by the experience of teachers, counselors, and educational psychologists.

When children are regarded fundamentally as individual learners, conforming to unique patterns of ability, motivation, and experience, there is then a statistical phenomenon of overlap that permits the discovery and organization of large common areas of curricular materials and classroom procedures. This overlap will be a function of group similarity in physique, mental ability, and social interest. There is a further restriction upon heterogeneity in the sense that children, in developing abstract abilities and achievements, tend to follow similar intellectual pathways. A sound psychology of mathematics, of reading, of general science will parallel, in broad outline, not only the systematic demands of the subject, but the climbing intellectual curiosity of the child.

As ability is unfolded in terms of scholastic achievement, some common pathways can be distinguished. This is far from saying that the dull child is the same as the bright child except in his rate of progress, for, it will be recalled, the factor of speed becomes so enmeshed in the whole concept of intelligence as to necessitate its incorporation within the definition. Only the psychologist whose work is validated by classroom and clinical experience, with full attention to various types of subject matter and to reenforcements available within the framework of school, home, and community, can map out convergent and divergent paths in pupil learning.

Every child, whether in a small group or a large classroom, must be expected to carry on a vast amount of self-teaching, self-correction, and self-adjustment. There is an inner check on efficiency that is, in essence, distinctly ethical. No child should be allowed to shortchange himself intellectually — to cheat at solitaire, whether it be played with cards, words, digits, or data. Within the limits of his knowledge and his ability to apply appropriate validation, the child is his own inspector general; he should never turn over to teacher, parent, or companion the smallest fragment of work that he knows to be wrong. He should get the habit of assuming full responsibility, let us say for a problem in arithmetic, composition, or science, within the limits of his power, leaving for the teacher only those duties that transcend his own. This crucial lesson, if learned early by every child, can be tremendously helpful to the teacher, supervisor, and curriculum maker. In the long run it will prove to be good training and good mental hygiene for the child himself.

This principle of self-help brings us immediately to the resources for mutual helpfulness within any group, large or small. A pupil who has attained mastery over a section of the work, who is demonstrably strong and reliable, should be nominated as an aid to the teacher. There will be no social difficulty about this, *if a good general rapport exists in the classroom.* Such a pupil, if sincere and of generous heart, will be acceptable to all the others and will himself prosper through responsible social participation. All the well-developed abilities of all the pupils should be thus utilized. In most classrooms there will be a few pupils, perhaps from impoverished neighborhoods, who seem to have little to offer. Among these there are sure to be found some interests or talents that wait upon the slightest encouragement for discovery and fruition. No task of the teacher-awakener can be considered more delightful than this one.

THE INFERIOR CHILD

Now a word for the unspoken question: What can be done for children who are in all respects truly inferior? If it were not for the special financial and medical problems, it is likely that public-school authorities could take care of the mentally deficient. As it is, the turning over to city, county, state, and private welfare agencies of a great army of the socially dependent, with correlated mental and physical deficiencies, has rarely been approached fundamentally as a problem in education. Factors in vocational choice, while qualitatively different at various levels of intelligence, are not more complicated for the deficient than for the gifted. Economic and social upheavals serve drastically to revise our ideas of the whole vocational problem. Under certain conditions ten million Americans, representing all levels of intelligence and demonstrated vocational fitness, will be out of work. This huge population includes hundreds of thousands of persons of high ability, although the percentage of unemployment or dependency will be greater among the dull and deficient. Unemployment during a social catastrophe is less an indication of low ability than of rigidity in occupational training and in the economic framework of society.

Large institutions for the defective that emphasize mechanical and agricultural crafts, condemning their population to a life in permanent confinement, are not the last word in social progress. There is evidence (a striking example is the Belgian Colony in which 3,000 persons are provided with medical care and vocational supervision in a city whose population is 18,000) favoring the desirability of breaking up large institutions, assigning the inmates to special colonies, villages, and towns under varying degrees of supervision. The institution for the feeble-minded, like the school, prospers proportionately to its success in becoming a part of the community, serving it in useful, if humble, ways, and deriving for its patients and wards a large measure of social belongingness.

Is there any animal so dull, so unresponsive, as to resist man's efforts toward domestication? For the lower strata of humankind, we have been unsure of our ground, fearing impacts upon the more fortunate, and disinclined to discover friendliness and usefulness. With talk so much upon us, and machines so plentiful, can we not afford some contact with lowly persons who are neither thought-ridden nor machinelike, but given to a peaceful devotion to their tasks and to a feeling for the simple and the primitive?

It is evident that the number of defective school children has been reduced by various sieving procedures. There will be whole classrooms in which no child is revealed to the others as a dunce or a scapegoat. In any case, the teacher can avoid this extremity by the method used in boys' camps. All counselors have discovered that they get boys who cannot excel in sports or feats of skill. Awards or badges of merit (the camp equivalent of school marks and citations) are granted in terms of such delightful characterizations as neatness, cleanliness, and cooperation. A democratic spirit that recognizes a division of labor adjusted to different levels of talent, interest, and drive need not thereby deprive any child of a sense of dignity or social usefulness. This difficult lesson can be taught better in groups than in a bilateral tutorial situation, and possibly as well in large groups as in small.

THE PROBLEM OF PROMOTION

In any school, pupils who are gifted in terms of a particular talent (drawing, music, mechanics, histrionics, and the like) demand special attention. What they need, in quality and quantity, may well exceed the energy and ability of most classroom teachers. The plan of rapidly promoting precocious children, with the thought that the sixth-grade teacher has something that the fourth-grade teacher lacks, is faulty in both theory and practice. More often than not, the sixth-grade teacher will be as baffled as her predecessors in discovering what is right and good for fast-growing, gifted children, and she will face the added difficulty of adjusting a young child to older companions.

So little of the total ability of any child is encompassed within the single measure of a high IQ, that attempts to revolve a curriculum and a complete personal life about this thin axis are foredoomed to failure. To ignore signs of high scholastic ability is equally costly and depressing. It condemns promising children to boredom and builds up habits of laziness and woolgathering. A further effect lies in the diminution of the talent itself: talents, like trees, must be watered early and copiously if full growth is to be the outcome. It would appear that the old Batavia plan of having two teachers in a classroom, one particularly trained to relieve the other in special curricular and advisory functions, still has much to commend it.

The need for special attention tc the dull and the subnormal in any school is obvious, and it is double-barreled: under conditions of laissez faire these failing children plague the teacher and act as a constant drag upon classroom activities. Later, emerging from a long experience with scholastic neglect and parental misunderstanding, they will constitute a replacement center for the recruiting of vocational misfits, delinquents, and criminals. For these children, a fixed verbalized curriculum that is fragmented, graded, and timed will always be anathema, whatever the standards: nor is such a course of study the most inspiring for average and gifted children.

The dilemma that faces classroom teachers, supervisors, and principals is clear. They know that favorable ratings of child ability or achievement will be regarded as a ticket of admission to the grade above, and finally to the senior high school and college. The decreasing tendency to "fail" pupils in terms of any fixed criterion indicates a recognition of this problem by school people, the whole concept of failure having been tinged with moral judgment. To fail in school was not to get placed in the most appropriate grade, but to be singled out for criticism and disgrace — a dispensation not unrelated to the financial, social, or political standing of the parents involved. Moreover, this system involved the assumption that more of the same teacher, the same methods, and the same subject matter would reform the pupil. There was also the hope that an extra year of mental age, or such portion of it as a dull child might develop in a given year, would resolve the difficulty.

TABLE 28[1]

A COMPARISON OF THE PERCENTAGE OF MENTALLY SUPERIOR AND MENTALLY RETARDED CHILDREN DESIGNATED AS PARTICIPATING IN THE VARIOUS EXTRA-CURRICULAR ACTIVITIES (BY SEX)

Extracurricular Activity	*Boys*		*Girls*	
	Superior	*Retarded*	*Superior*	*Retarded*
Music	47	24	59	37
Organized sports	33	35	20	23
Unorganized sports	45	49	38	44
Dramatics, forensics	13	6	20	15
Academic clubs	9	7	8	10
Avocational clubs	9	8	8	11
Social clubs	9	8	11	10
Scouting, campfire	25	18	30	16
Service clubs	10	10	10	11
Student government	9	7	8	7
Number of cases	1,279	1,890	1,923	861

Interests and Activities

Lewis and McGehee[2] have reported findings on the interests and activities of special groups of children. Their sampling was based on the Kuhlmann-Anderson test which was administered to children in elementary schools (grades 4 to 8, inclusive), widely spread over the country. A pupil was designated "mentally superior" if he stood in the top 10 per cent on the test, and as "mentally retarded" if he stood in the lowest 10 per cent. The principal data are given in Tables 28 and 29.

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[1] From Lewis and McGehee, p. 598.

[2] Lewis, W. Drayton, and McGehee, William: A Comparison of the Interests of Mentally Superior and Retarded Children. *School and Society*, 1940, 52, 597–600.

TABLE 29[1]

A COMPARISON OF THE PERCENTAGE OF MENTALLY SUPERIOR AND MENTALLY RETARDED CHILDREN DESIGNATED AS INTERESTED IN THE VARIOUS HOBBIES (BY SEX)

Hobbies	*Boys*		*Girls*	
	Superior	*Retarded*	*Superior*	*Retarded*
Reading — novels	50	23	60	31
Reading — history, science	31	9	22	9
Reading — funny papers	49	39	50	41
Active games, sports	67	54	42	38
Quiet games	26	15	29	24
Playing musical instruments	22	10	28	11
Listening to radio	39	30	37	29
Sewing, knitting	3	4	36	34
Housework	7	8	32	40
Going to shows	33	30	34	29
Dramatics — participating	9	4	16	6
Playing make-believe games	9	6	24	17
Religious activities	17	11	21	15
Building things, shop work	34	27	4	3
Traveling	13	8	11	8
Driving a car	7	9	3	3
Studying	9	4	11	6
Working — farm, store, etc.	10	17	3	5
Clubs — social, dancing	4	2	9	6
Scouting, or other serious forms of club activities	13	6	10	4
Collecting	30	9	22	9
None	1	14	1	12
Number of cases	1,700	3,009	2,505	1,618

Since the data were furnished by teachers who responded to a check list of the ten extracurricular activities and twenty-one hobbies reported in these tables, the percentages are only a rough estimate. Both mental test score and teacher rating would shift in the course of differential school, home, and community experience. The authors remark that "there is some relationship between a superior interest in music and superior mental ability." A sex difference in this respect appears important, for 47 per cent of the superior boys and 37 per cent of the retarded girls participate in music. Considering the pressure on retarded pupils to keep up with their schoolwork, together with the probability that these children find meager cultural resources at home, it is remarkable that they display so wide a spread of interest and activity. Retarded girls, for example, show as much interest in dramatics and forensics as superior boys — an indication that the *schools* are "retarded" in supplying appropriate opportunities to pupils. In view of other studies that show no great divergence between boys and girls at this age with respect to aptitudes in shopwork and construction, the percentage of 27 for retarded boys and 4 for superior girls leads us to question the theory and practice in the 455 schools represented in the survey.

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[1] From Lewis and McGehee, p. 598.

There Is a Distribution of Talent at All Levels

Perhaps elementary-school teachers are misled by the supposition that in high school and college there are found classes homogeneous with respect to mental ability and previous accomplishment. As a matter of fact, every survey of high-school, college, and university students, straight through to the last year of graduate work for the Ph.D., has shown a tremendous range of talent. This state secret was publicly revealed a few years ago:[1]

> . . . we must recognize the existence of a distribution, perhaps a bell-shaped distribution, even at the doctoral level. In knowledge, achievement and originality the best Ph.D. is as far ahead of the poorest Ph.D. as the best senior in college is ahead of the worst. How did we ever hit upon the pathological idea that we could cut off talent *at the top?* The only thing we ever should attempt to do, in my judgment, is to delimit talent at the bottom — to make sure that the academic plateau upon which the senior or master's or doctor's candidate sets his feet will be considered decent and defensible. (Some Ph.D.'s, I suppose, should be in homes for doctoral delinquency — in a burst of top form in the easiest department of the lowest ranking graduate school, with a degree-requiring job around the corner, they barely got by the most lenient committee that could be assembled!) (p. 129.)

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[1] Stoddard, George D.: Some Current Issues in Graduate Work. *School and Society*, 1938, 48, 125–132.

Eurich,[1] utilizing data from the psychological examinations of the American Council on Education, provides a good illustration of the individual differences to be expected as between colleges, and within any given college:

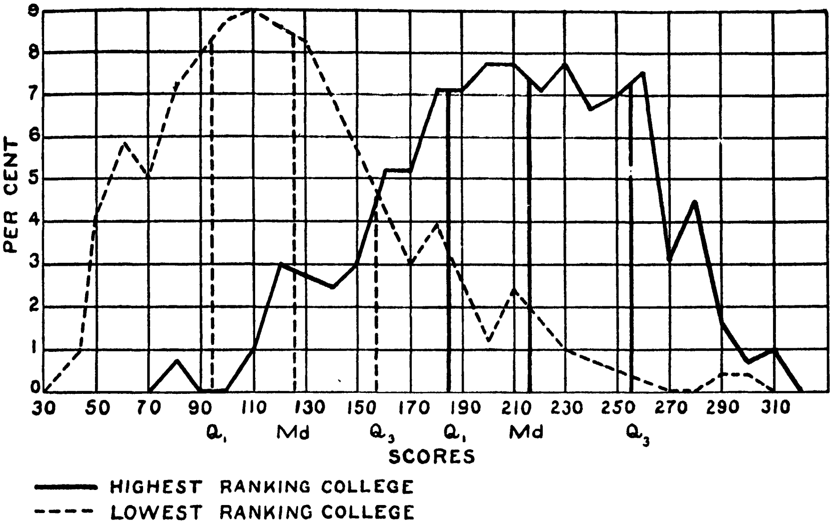

Fig. 41. Distribution of Scores on the American Council Psychological Examination for Two Four-Year Colleges. (From Eurich, p. 79.)

On the basis of the curve in Figure 41, Eurich observes:

> The educational program, insofar as it involves the abilities measured by such an examination, must be adjusted to the students who are being served. Actually, colleges and secondary schools have made such adjustments constantly, which they have not openly recognized. The teaching of college algebra or chemistry in the highest ranking college must be very different from that in the lowest ranking college. Algebra requires a high degree of proficiency in ability to use abstract symbols or the kind of ability that is appraised by the psychological examination. To say that the students in the two groups had learned algebra to the same degree, or to say that they can and should learn algebra to the same degree, represents sheer rigidity in educational thinking. It represents an insistence upon absolutes in college education that do not exist.

More amazing still than the differences between institutions on their psychological test scores is the wide range of scores within any

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[1] Eurich, Alvin C.: Youth in the Colleges. The Thirty-Eighth Yearbook of the National Society for the Study of Education. Part II. *General Education in the American College.* Bloomington, Ill.: Public School Publishing Company, 1939. Pp. xii, 382. (pp. 73–96.)

> single college. In the two colleges represented, for example, it is obvious that the lowest includes some students who rank in the top one fourth of the distribution for the highest. Furthermore, the highest includes some students who rank in the bottom fourth of the distribution for the lowest. Each college, then, faces a problem of variability within the institution that has been talked about often enough, but has been the object of serious efforts to meet individual needs only within the last few years and even so with most inadequate results. (pp. 79–80.)

Boys and girls of low ability are sent to college in droves. There they thrive less on the academic essentials at the core of most colleges than on events designed for the relaxation of the intellectually elite. Youth of this type add tone and color to any college; surprisingly enough, they need never be lonely in contact with fellow students, faculties, and alumni groups: at first tolerated in deference to their physical or social attributes, they penetrate the inner circle of the scholastics, widening the doors by which they enter and leave.

At any level of instruction the scholastic recidivist is something of a bore. He is all too familiar with teacher idiosyncrasies, and in spite of failing, has probably learned some of the materials to be presented painstakingly to the new batch of pupils. To say that the child is resigned to a second year under these circumstances is to put it mildly. How could he be prepared physically, mentally, or emotionally for a simple repetition of what he has just been through? Even the eraser-cleaning and errand-running which might afford him some relief from ennui are probably denied him in favor of brighter children.

Binet's principles[1] are still of interest; they give historical perspective to recent attempts to define and establish activity programs:

> . . . Un enseignement est mauvais s'il laisse l'élève immobile et inerte; il faut que l'enseignement soit une chaîne de réflexes intelligents, partant du maître, allant à l'élève, et revenant au maître; il faut que l'enseignement soit un excitant, déterminant l'élève à agir, et créant en lui une activité raisonnable; car il ne sait que ce qui a passé non seulement par ses organes des sens, et par son cerveau, mais encore par ses muscles; il ne sait que ce qu'il a agi. Philosophiquement, toute vie intellectuelle consiste dans des actes

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[1] Binet, Alfred: *Les Idées Modernes sur les Enfants.* Paris: Ernest Flammarion, 1911. Pp. 346.

> d'adaptation; et l'instruction consiste à faire faire à un enfant des actes d'adaptation d'abord faciles, puis de plus en plus compliqués et parfaits. Voilà pourquoi les leçons de choses, les promenades, les travaux manuels, les exercices de laboratoire sont aujourd'hui tellement à l'ordre du jour; ils répondent à ce besoin de mise en activité des élèves. Entrez dans une classe; si vous voyez tous les élèves immobiles, écoutant sans peine un maître agité qui pérore dans sa chaire, ou encore si vous voyez ces enfants, copier, écrire le cours que le maître leur dicte, dites-vous que c'est de la mauvaise pédagogie. J'aime mieux une classe où je verrais des enfants moins silencieux, plus bruyants, mais occupés à faire le travail le plus modeste, pourvu que ce soit un travail où ils mettent un effort personnel, un travail qui est leur oeuvre, qui exige un peu de réflexion, de jugement et de goût. (pp. 156–157.)

Variability at all academic levels being what it is, nobody would conscientiously try to increase it. After the teachers have explored the total resources of a school, envisaged as a working-part-of-a-community, and have built up sequences and grades consistently with a wide central tendency of pupil need, they will find a few cases whose fringelike attachment to the program is not conducive to personal growth or classroom morale. (It is assumed that the worst cases of deficiency have already been screened out and are being taken care of in special colonies or institutions.) For these pupils some curricular adjustments and cooperative arrangements are indicated, as in ungraded classes and the strengthening of residual abilities. Since there is, moreover, the problem of recording and certifying scholastic achievement, the cumulative record plan would seem to be of paramount importance. It permits each teacher, as she receives a child, to locate his work in a consistent sequence of events — to call upon review, refreshment, and appropriate alteration. Whether or not separate tracks are provided, every child deviates from all the others, perhaps so radically as to be only superficially classified by a grade designation.

In the early high-school years, around the limits of compulsory schooling in most states, there will arise the need for a decision as to further promotions or expectations for the duller children. Unless these decisions are made in terms of the needs of youth, the limitations of schools will set unnecessary bounds to the development of social and vocational learning. The recent history of governmental enterprise in special education and guidance, together with the wartime demand for boys and girls trained in technology, illustrates our real concern for the productive capacity of young persons, irrespective of their verbal aptitudes. At long last, the schools may be able to recognize and develop talents in terms of what the child has to offer and the country has to have, rather than to spread liberally its notations of "low ability," "failed," "not recommended for promotion," and "not certified for high school."

The Question of Vertical Articulation

Any college or university is privileged to test the graduates of the secondary school from whatever source, imposing its own standards of admission. As an institution, it need not be concerned about what happened in the elementary grades, or for that matter, in the particular offerings of the secondary schools. Since secondary schools, public or private, often consider themselves as primarily preparatory to college, they can be counted upon to adjust their curricula to the expectations or examinations of the higher institutions. Thus the problem of articulation is solved — but not necessarily in the best interest of the students. A high-school or preparatory-school boy is an intellectual, personal, and social entity whose forward look, while natural and strong, should not be a dominating characteristic. In everlastingly preparing for something to come, youth is not infrequently debarred from the emotions, experiences, and accomplishments appropriate to its own society.

For a state university that accepts the product of the secondary school, at least from the state itself or a designated region, the problem of securing a highly selected student body, while acute, can be met. If it is really known what patterns of secondary accomplishment are appropriate for the continuance of subject matter at the higher levels, the entering students can be tested accordingly. In view of the findings of Walter C. Eells in California, and others subsequently, to the effect that there is little connection between a particular secondary curriculum and success in the university, the search for talent is no harder in the high school-state university sequence than for the preparatory school-private university. The advantage enjoyed by the latter is not in terms of the all-round abilities of students (which, in either sequence, is a function of the adjusted percentile ranking of each student in a composite of academic subjects), but in the ability to connect course I at the secondary level to courses II and III in the university. There are so many breaks between free-wheeling high-school curricula and Eliot-imposed course options in the university that the two may be considered out of phase: much ground must be covered and recovered in a particular subject matter, if the student is to have any sense of systematic development. Without thorough examinations and exploratory opportunities, as in a freshman week, together with good plans for individualizing the student's progress, there will be, at any subsequent academic level, a noticeable backing and filling. This may show up in comparisons between most state universities, on the one hand, and universities holding to entrance examinations — for example, in the type of materials comprising the Carnegie Record Examinations.[1]

THE TEACHER AND THE PSYCHOLOGY OF LEARNING

As source material for the classroom teacher faced with a roomful of children, the psychology of learning is somewhat meager. While emphasizing individual differences, it has done little to describe them in detail or to delineate significant changes and interrelationships as the child grows up. Moreover it has tried, without much success, to build up an understanding of the child in terms of two disparate foundations, namely, the lower animals and discrete school subject matter. A knowledge of the process of thinking in the normal child, and especially of the difficulties, blockings, and sidetrackings that he experiences, as strikingly portrayed by Piaget for young children, has scarcely penetrated the scholastic lines.

Witty and Kopel[2] furnish an illustration of this problem in the field of reading disability, as follows:

> . . . procedures in reading instruction of all types often reflect outmoded tradition, chance, or caprice. Although teachers occa-

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[1] The Graduate Record Examination: *A Memorandum on the General Character and Purpose of the Examination Including a Summary of Initial Studies of Its Validity.* New York: The Carnegie Foundation for the Advancement of Teaching, 1941. Pp. 38.

[2] Witty, Paul A., and Kopel, David: Causation and Diagnosis of Reading Disability. *Journal of Psychology,* 1936, 2, 161–191.

> sionally are unjustly blamed for their dilatoriness in affecting reform in this area of instruction, one should be charitable indeed since nowhere in the voluminous literature can one find an account of causal factors and diagnostic procedures for remedial endeavor in reading which is very useful or adequate in terms of the varied needs of typical classrooms. . . . Particularly regrettable in the usual routine is the failure to conceive *reading as a thinking enterprise — demanding the use of creative intelligence in situations inextricably associated with the total complex development of the growing child.* Furthermore, maximum growth is frequently arrested or precluded because we do not recognize fully the operation of the numerous factors contributory to reading efficiency — as parts of a highly integrated process in which reading is considered efficient *only if meanings are grasped, sensed goals attained, and knowledge organized.* (pp. 161, 186–187.)

At various points the Forty-First Yearbook on learning attempts to fill in the gaps and to map out further areas of inquiry. After reviewing the literature, Horn[1] concludes:

> In the light of our present knowledge of the relation of intelligence to achievement, it would be rash to estimate the limits of intelligence below which the understanding of any given problem is frustrated. Understanding is a matter of degree, and every student may reasonably be expected to achieve some grasp of any problem pertinent to the common needs and activities in his community. There is an abundance of evidence, however, which shows that under conditions commonly found in schools, students of the lower levels of intelligence develop very inadequate understanding of many of the more complex problems which confront them. (p. 396.)

Since we know almost nothing about the content and operation of children's minds during periods of learning and nonlearning, there is indicated a rich field for exploration. Massive statistical surveys, while useful, rarely get down to the living child in a particular situation. For example, under well-controlled oral conditions, the child would display various attempts at the solution of a problem, perhaps verbalizing almost everything that came to mind. In this way, raw material could be obtained for a kind of analysis not possible within the framework of a standardized mental or achievement test. The plan would involve more than a hunt for recognizable maladjustments and mental deficiencies, although some of these would show up; it would include a search within the child for the *source* of certain mental inadequacies and frustrations — for the small divergences that lead to poor methods, misdirected activity, and false knowledge.

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[1] Horn, Ernest: Language and Meaning. The Forty-First Yearbook of the National Society for the Study of Education. Part II. *The Psychology of Learning*. Bloomington, Ill.: Public School Publishing Company, 1942. Pp. xiv, 502. (pp. 377–413.)

We need to know better than any existing study can tell us the effect of studying and not remembering, of piecemeal learning that falls short of mastery. We need to extend the principle involved in diagnostic testing (which is good as far as it goes) to demonstrations and experiments that, as it were, get *inside* the child's thoughts and emotions. We need to know more about periodicity in the acquisition of insights, and of the inhibitions, sometimes retroactive in character, that rub out impressions while others are being stamped in. Since a vast pile of detail accumulated in school learning will be forgotten, we need further insight as to what will be retained, and under what reenforcing circumstances.

Transfer of Training

Observers like Bagley [1] may be right in holding that the momentous question of mental discipline, or the transfer of training, is not as yet truly answered:

> . . . the records of the investigations from the psychological laboratories . . . taken as a whole, far from invalidating the doctrine of mental discipline, actually support a reasonable faith in its tenets. (p. 164.)

Of course, as Bagley goes on to say, part of the difficulty may be semantic, in that we tend to ascribe new values to old verbal currency. Nowadays *discipline* is not a good school-word, and the connotations of *transfer* and *training* are obscure. From what we have noted in the upbuilding of intelligence-as-tested (scholastic aptitude) and presumably of intelligence-as-conceived (development of abstracting and originating powers), we may postulate that some school subjects will "transfer" better than others and on a broader scale — particularly that any great congeries of language experience, as in the Latin that Bagley defends, could serve this purpose. If we view it in this evolutionary, nonmystical fashion, we can no longer regard the matter as having been satisfactorily explored. The theory implied is not so much a *transfer* of anything, as a *multiple action;* the reservoir fed by many streams may irrigate through countless ditches.

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[1] Bagley, William C.: Latin from an Educationist's Point of View. *Educational Administration and Supervision*, 1941, 27, 161–167.

WHEN THE TEACHER KNOWS HER PUPILS

A full knowledge of any group of children would comprise data from experiments, analyses, tests, and clinical observations, all to be included within a dossier to be accumulated over the years and passed on to succeeding teachers. Some material that is now kept within the files of the clinician should be available for the classroom teacher. She should be trusted with a complete knowledge of her children, in the same way that a nurse is expected to understand and be guided by the diagnosis of the physician. This means that every teacher should have a grounding in child psychology. There should continue to be, in the larger systems, a well-organized guidance clinic, and in the smaller ones, at least a division of labor. A visiting teacher, a principal, or a committee could exercise special functions after securing the necessary training.

To do all this requires no extension whatever of the aims of a standard school, for these responsibilities, while shared by parents and physicians, are directly connected to learning. So far as I know, the utmost perfection of curricular content, textbook, and objective classroom procedure will not suffice to bring each child up to his highest level of learning and adjustment. The springs of action within him, if flowing freely, will indeed be facilitated by improvement in that direction, but efficiency is no substitute for the mobilization of power that comes with mutual understanding and the unconscious application of democratic principles. Children's minds work best when the loyalties of their hearts are fully engaged: the best procedures are those built upon this rocklike foundation.

As we learn more about neurotic and psychotic involvements among children, we realize that they are in essence a revolt, a turning away from socially approved choices because every one of them is considered unacceptable. The child moving toward delinquency or psychopathy is maintaining the integrity of his own impulses and needs, in spite of the pressure of society to keep him on the "right" track. From experience and clinical observation, the psychologist knows that these private ways are unhealthy and disastrous, but the child, sensing a new freedom of mental and emotional action, within the bounds of a warped or split-off personality, has no such long-time view. He avoids what he regards as intolerable, whether it be spelling, arithmetic, punctuality, cleanliness, teacher criticism, parent criticism,. or regard for others. The whole process is, to some extent, understood by normal children and adults in the situation, for under special circumstances they themselves display similar tendencies. Those who keep an even keel are stable, not because they never pitch or roll, but because they manage to return to horizontal.

Teachers and parents are favorably situated to observe departures in learning or behavior that are out of line with respect to the known character of the child, or the general social expectation as corrected for community, nationality, and race. *For the school child, a defect in learning is a total defect.* He has been made to believe that school is the main business of his life; any experience with failure goes far to confirm the idea. When parents support the school in demanding a high scholastic achievement, it may seem to a child that there is a collusion against him. When parents pass lightly over hard pressures exerted by teachers and school authorities, the child is not much better off, for now he is confronted with a major division among equally potent adults.

In the long history of the school as a social institution, thousands of teachers must have failed miserably, each in a lifetime of trying, to impose upon any child sound habits of learning, behaving, or enjoying, for they themselves were out of touch with children and with the times.

Aikin[1] in his account of the long-time study of thirty secondary schools, under the auspices of the Progressive Education Association, visualizes the type of teacher demanded, if curricula are to be liberalized:

> Each teacher needs competence in his own field, of course, but he needs a broader competence. Fusion courses, broad fields, culture-epochs, career-centered courses, core curriculums — all these are designed to meet youth's needs more directly. They require teacher collaboration. This unity of teacher effort demands the breaking down of artificial barriers which have separated teacher from teacher and subject from subject. It also calls for the removal of

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[1] Aikin, Wilford M.: The Story of the Eight-Year Study. (*Adventure in American Education*, Volume I.) New York: Harper & Brothers, 1942. Pp. 157.

> the limitations which have prevented teachers from becoming truly educated persons themselves. When they work together, they learn from each other. When they consider the whole responsibility of the school, they gain insight into the implications and relationships of their fields of work. (p. 137.)

When the quality of a child's all-round progress up through the school years, and outward into vocational and civic responsibilities, is regarded as the true mark of a teacher and a school, we shall have gone far to restore to children their ancient rights as adults-in-the-making. That this need not involve the substitution of child tyranny for teacher tyranny is indicated in the passages quoted below:

> It cannot be said that ordinary elementary schools require the child to learn too fast, but only that they do not require him to learn well. Material raked up only from textbook statements "about and about" is no substitute for the genuine comprehension which comes from first-hand experience, whether the subject be arithmetic, nature study, or dramatics. The optimum speed of learning for a given child can be observed best in the classrooms of liberal and progressive schools or in freely chosen activities, such as reading, collecting, camping, playing games, acting, planning, or organizing.
>
> The prime condition of learning is a strong sense of need. No amount of expert battering from without can break down the resistance of a child who, fundamentally, does not want to learn. But a school that habitually houses children who do not want to learn is a contradiction in terms; and more — it is a disgrace to the community. For most children were not born that way, and their parents, unless more expert in malice and stupidity than real parents ever are, could not have quenched the deep-lying drive to question, to imitate, to explore, to learn. At this age, resistance to learning is a perversion, an abnormality, an intellectual loss of appetite, which is thoroughly shocking to anyone who has known these children in the full flush of their preschool years. Of course few schools encounter such a situation in the raw; but some slip into it insidiously, so that, grade by grade, the children go down hill. They learn less, they play less, they do less. Such children are being starved at their cultural roots. What might have been a glorious journey up through the school grades degenerates into dogged attempts to acquire innumerable items and skills which are retained long enough to "get by," but by graduation have sunk unpleasantly into the unconscious. (p. 43.)[1]

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[1] Stoddard, George D.: Adventures Toward Independence. *Child Study*, 1935, 13, 41–43.

What parents and teachers may have done to raise this mountain of discouragement can be gleaned from the recent studies of Lewin and his associates. In a study of frustration and regression,[1] they have described and analyzed, for individual children, the fundamental regressive effects of situations commonly met in childhood. Under conditions in no sense extreme, these children displayed a remarkable restriction in fundamental abilities which, if intensified and continued, would undoubtedly have led to the standard symptoms of deficiency. In studies at the upper grade-school levels,[2, 3] Lewin has carried out unique experiments the results of which lend strong support to the desirability of democratic procedures in education. Neither laissez faire, which may be identified with the earlier procedures in progressive education, nor dictatorial methods, which may be likened to education under "good discipline," are found to be effective; they carry the germs of inadequacy, irrationality, and rebellion.

We can never know how closely school children may approach an ideal until we place them squarely at the center of the educational world. They themselves are the touchstone by which to try any proposed reform in education. They are the plastic raw material and the end product. No one ever asked to be placed in a poor school; if kept there too long, he will be reluctant as an adult (having honeyed over his school life with the sentiment of passing years) to give his children enriching experiences: he will be swayed by the easy labels of "luxurious," "new-fangled," and "radical." Improvements which, as a farmer, laborer, or businessman, he comes to regard as *progressive* may be effectively blacked out when applied to schools. How, otherwise, can we account for the common spectacle of the well-to-do farmer, driving up on a paved road to discuss with other members of the school board how most cheaply to repair a decrepit, one-room school as outmoded as a hitching post, and how to secure an equally outmoded teacher at $70 per month?

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[1] Barker, Roger, Dembo, Tamara, and Lewin, Kurt: Frustration and Regression: An Experiment with Young Children. *University of Iowa Studies in Child Welfare,* 1941, 18, No. 1, pp. xv, 314.

[2] Lewin, Kurt, and Lippitt, Ronald: An Experimental Approach to the Study of Autocracy and Democracy: A Preliminary Note. *Sociometry,* 1938, 1, 292–300.

[3] Lewin, Kurt, Lippitt, Ronald, and Escalona, Sibylle Korsch: Studies in Topological and Vector Psychology I. *University of Iowa Studies in Child Welfare,* 1940, 16, No. 3, pp. 307.

The IQ and Homogeneous Grouping

It is unlikely that the classroom teacher should carry on Binet testing or utilize the intelligence quotient as a single datum. As we have seen, the IQ has a restricted meaning; it must be hedged about with clinical observations that make it the special concern of psychologists and psychiatrists. These professional workers, buttressed with other types of tests, observations, and experiments, can fit everything into place and make practical recommendations. The regular teacher, even if skilled in the mechanical administration of mental tests, will find them as hard to interpret as the special findings of the school physician. The teacher will be more at home with tests of achievement and special aptitude which do not lead her into the temptation of classifying all children as dull, average, or bright.

In the same objective spirit in which transfer of training should be reexamined, it will be well to look again into the question of grouping children "homogeneously" in terms of IQ ratings. If she understands child behavior and has full access to test, clinical, and cultural data concerning her pupils, together with provisions for flexibility and enrichment within the curriculum, the grade-school teacher is well equipped to provide for large individual differences — perhaps for all but the extremes of the distribution. The child who has difficulty in learning to read (he may be afflicted with sensory and motor defects) will require special treatment; under some circumstances, he may better stay at home, receiving tutorial or radio instruction. The gifted child need not be bound down to the slower pace of his companions; for him, the typical gross error is the expectation that he should do exactly what the other children do, leaving him at school's end younger than the others but scarcely wiser. Since standards are low in many schools, bright children can take up some of the slack by setting a faster pace, in combination with far higher standards of accuracy and mastery than are usually demanded — in short, at all levels, a supreme emphasis on full knowledge, deep insight, and originality. Their intellectual range makes it desirable to give them wide freedom and highly set goals in various cultural areas.

WHAT EVERY CHILD WANTS

Certain aspects of liberalization would prove profitable to children at any range of intelligence from the dull-normal upward.

The principle can be illustrated by excerpts from a superintendent's report, as quoted by Sumption.[1] It is suggested that wherever the word "superior" (or any other term signifying unusual talent) is employed in the description that follows, the reader replace the term by the word "ordinary"; it seems unlikely that the experienced teacher would thereupon reject a single one of the superintendent's statements:

> If the school is the place where the powers of superior children should be loosed and used to their fullest extent, then the curriculum, both in content and administration, must be sufficiently flexible, varied, and challenging to care for the diverse needs of the various members of a given group. In common with all children, the mentally superior child possesses some unevenness in his abilities. When the pupils of superior ability have been located, the problem resolves itself into providing for them room to grow and freedom to develop their powers to the full, and into furnishing an incentive to make constructive use of their creative power "for the good alike of themselves and of society."... Compliance with the conventions of spelling, punctuation, grammar, and basic mathematical processes is expected of all adults who are to function in the community.... Administration and enrichment are the individual teacher's problem, a flexible situation at once fraught with much joy and responsibility and providing the necessary room for teacher and pupil growth. (pp. 43-45.)

What has been omitted in the abridgment above is, for the most part, more of the same, although there are references to the special abilities of gifted children and to work in conversational French, reading, and literary production. Pupils screened out as "gifted" by means of heavily verbalized tests will be wide readers and more successful than other children in the language arts. In all the other activities mentioned, including the fine arts and crafts, together with the intellectual and social qualities that remain undistributed in Binet testing, we should expect a strong community of interest throughout a classroom or school.

Not every child wants to do the same things, but the things that he wants to do may be said generally to sustain educational and civic values. In the ages of childhood prior to extreme mental and vocational differentiation, the pool of shared interests is of paramount importance. So predictable are the ultimate needs of adults in terms of general knowledge, personal behavior, citizenship, and social responsibility, and so various in terms of explicit learning in support of a specific vocation (which may require only a few months' apprenticeship), that the modern worker is right in emphasizing the former as the solid core of education for childhood and youth, postponing the vocational and professional emphasis until a time when the aptitudes of the child have crystallized.

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[1] Sumption, Merle R.: *Three Hundred Gifted Children: A Follow-Up Study of the Results of Special Education of Superior Children.* Yonkers-on-Hudson, New York: World Book Company, 1941. Pp. xviii, 235.

THE GIFTED PUPIL

For the child whose early aptitudes, as in music or art, appear authentic and extraordinary, there is indicated a long period of cultural experience, within which, from the first, concentrated training in his medium may be embedded. For practically all schools, the chief error lies in depriving a highly talented child of special opportunity to develop and perfect his gifts. The musically able are hamstrung if they continue in the ordinary public or private school; in a special school they are allowed to do so much work in music as to be culturally deprived. Again, we should look within the child. It is unlikely that any child is so gifted in music that he lacks interest in everything else. If he rebels against ordinary schooling, it is because he is kept from devoting a tremendous amount of energy to his major interest.

What we need for all talented children in a particular line, ranging in degree from the gifted to the genius, is a strong, constant, upward-spiraling core of instruction and encouragement within the special field. Surrounding this, and penetrating it in such a way as to expand his total knowledge of the world, there should be enriching academic offerings, similar to those recommended for all other children. This will bring us, in the long run, fewer artists-in-rebellion who validate their protest in terms of extraordinary accomplishment, without benefit of school curricula. Strangely enough, many secondary schools and colleges are quick to appreciate a felt necessity to exploit physical talent — they point the fine physique toward athletics. But the student who can write, compose music, or paint pictures, whose love is for the beautiful, is made to feel lost in a world of man-made ugliness.

Cox,[1] in her description of the education of John Stuart Mill, shows how far removed is anything attempted in special classes from the recorded impact of one mind upon another, in a close and long-continued tutorial relationship. Mill's father, James Mill, himself a distinguished man, taught him Greek at the age of three or four, and soon thereafter Latin, mathematics, and logic. Since he succeeded with all these, one is tempted immediately to grant the young child an extraordinary mental rating. Yet the bare fact remains that any bright child, given such extraordinary motivation and example, could go a long way in the same direction. The learning of Greek, if carried out under a master of Greek, is simpler than the learning of English, and there is no special difficulty in getting from oral to written Greek. Our selected preschools and kindergartens enroll hundreds of children who would astonish parents with their facility — provided the elders could teach like James Mill!

It is so in motor skills, mechanics, arts, and crafts: under appropriate guidance, children below the age of six give truly remarkable performances. Even in the crowding superficiality of the radio quiz or question-and-answer demonstration, it is known that audiences composed of professional educators exclaim in wonder at the range and accuracy of a child's lexicon of useless information. The experiment that needs trying, for truly gifted children (this group would doubtless include many of the radio performers), is to induct the child into intellectual experiences that are abstract, hierarchical, and systematic in structure — employing the ability to remember, spread out, and persevere in the service of a genuine art or science.

Obviously, for most children, it would be impossible to scale the heights later attained by John Stuart Mill. Perhaps John did receive "the utmost stimulation that it was possible to apply," and it can be assumed, in view of the final outcome, that his inherited structure was of the highest quality. A child of ordinary potentialities might have gone far under the tutelage of James Mill — or he might have become neurotic. A less-favored child, of high innate potentiality, might have been drowned in a sea of hard physical labor and cultural impoverishment, lacking the time, the energy, or the opportunity to do more than display ingenuity within occupations demanding no great backlog of learning. A great light could have been shed upon the meaning and process of education, if James Mill had thought to gather round him a dozen neighborhood children for the course of instruction so meticulously applied to his son, carrying each pupil up to his highest level of participation and accomplishment. We can postulate that a few would have been stopped dead in their tracks, but only a few. Others persisting could have gone far with the relatively uncomplicated curriculum of the early nineteenth century; more than one who was lost to contemporary affairs and to biography might have taken his place among the intellectually fruitful.

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[1] Cox, Catharine Morris: Genetic Studies of Genius: Vol. II. *The Early Mental Traits of Three Hundred Geniuses.* Stanford University, Calif.: Stanford University Press, 1926. Pp. xxiii, 842.

The nearest equivalent to John Stuart Mill's experience that I have been able to find is contained in a description of what, up to 1934, had happened to little Seymour:[1]

> . . . he was doubly promoted each term, until he entered the sixth grade at the age of eight and one-half years. . . . Like many superior children, Seymour preferred to be alone with his books, rather than to play with other children. He was required to play with other children. . . . He is interested in football, baseball and basket ball and is an excellent swimmer. Many of the books Seymour read were taken from his father's library, which contained more than 100 books for children. His reading has always been supervised, but he has been permitted to make his own selections from a preferred list of books. . . . At an early age Seymour became familiar with many of the best musical compositions, for it is the family custom to play selections from his father's collection of 400 classical records during the dinner hour. When he was in kindergarten each one of the children was asked to sing a song. Most of them responded with a nursery jingle, but Seymour sang an aria. . . . He has heard addresses by some of the most famous men including Lindbergh, Byrd, Ramsay MacDonald, Mussolini and Gandhi. . . . At his own request he was given private lessons in Hebrew. . . . He began to take violin lessons at about seven and a half years of age. He now practices an hour and a quarter each day. . . . He loves to experiment with chemicals and is familiar with many of the formulae. He keeps his classmates supplied with ink. . . . Every other Saturday morning he goes to the dentist, as he is having his teeth straight-

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[1] McElwee, Edna Willis: Seymour a Boy with 192 IQ. *Journal of Juvenile Research*, 1934, 18, 28–35.

> ened. . . . He is somewhat handicapped by defective vision (corrected by refraction), by a slight speech impediment, and a nervous mannerism. The traits of character his parents consider him to possess in a marked degree are prudence, self-reliance, will power, desire for knowledge, desire to excel, originality, conscientiousness, truthfulness, sympathy, cheerfulness and a sense of humor. . . . He thinks people are always looking at him and making remarks about him. . . . He thinks he is even regarded as queer. (pp. 29–34.)

It will be interesting to see how two divergent lines in this boy's personality, the one to validate his high Binet IQ in terms of all-round intelligence, the other to move toward the psychoneurotic, are developed with age. The early appearance of speech and nervous difficulties may possibly be symptomatic of excessive pressure and of expectations somewhat beyond the boy's ability to deliver the goods.

Thus far there have been only opportunistic demonstrations of the power of a *particular* environment to push potentiality to its limits, limits that for some reach up into the genius levels. The greatest general aid to talent has been, of course, our grand system of public education with its extraordinary superstructure in academies, institutes, colleges, universities, and research laboratories. Theoretically the least matrix for genius can be envisaged as couples in this manner: (1) the finest innate structure and a modicum of education; (2) excellent innate structure and excellent education; (3) ordinary innate structure and the finest education. These combinations do not guarantee the appearance of the individual genius; they simply affect statistical chances. It follows that the best education and all-round environment would be most productive of genius for any given distribution of raw materials. (We know that nervous structure and function *develop:* the period of infancy is a means of getting the most out of a nature-nurture collaboration.)

It may be expected that a society providing effective education would in turn cherish the products of genius. It would enjoy the fine arts, while training, encouraging, and rewarding the artist. It would try to prevent a repetition of the miserable fate of many artists of the first water who, in a world accustomed to luxury, lacked the bare necessities of life.

ADOLESCENCE

While we have come a long way from proclaiming a one-to-one relationship between chemical and physiological events peculiar to pubescence and various mental conditions, there is no question about the profound change in the organism that takes place at this time. The effects set in earlier for girls, bringing them to full physiological maturity perhaps a year or two in advance of boys. While the new forces within the body may set the stage for endocrinal disturbance, and there is a need for establishing new social relationships consistently with biological change, the adolescent period of life is, on the whole, marked by increased strength and the piling up of reserves of energy. The relationship to mental ability of any observable spurt in physical growth, or of the primary and secondary characteristics of sexual maturation, is unknown. Practically all the attempts to establish correlations in this field are based on Binet testing, which is almost useless in differentiating scores in the upper half of the distribution.

Consistently with the general thesis in this volume, we may expect maladjustments in personality and behavior to affect the progress, and at times, the final level of intelligence, for ratings of intelligence involve a resistance to emotional interference. If, for any reason whatever, the adolescent becomes illogical or irrational, as in judgments concerning parents, teachers, members of the opposite sex, or vocational preparation, this will contribute to a lowering of his general mental adequacy. The fault may lie with adults who fail to understand that the child is growing up, being no longer quite a child nor yet a man but expected to act like either, depending on the occasion. After organic changes have made their appearance, adults frequently magnify the hazards of social relations. Their taboo on sex information and sex activity now colors all their attitudes, for everyone is caught in the framework of a striking dislocation as between biological maturity and socioeconomic readiness. Man, having come up from a wilder state in which the new generation was launched as soon as it could be (in the early teens for the girls), has succeeded in lengthening the period of his social infancy, demanding, in advance of marriage, much in the way of education, finance, and regularity. Hence the years *beyond* adolescence, when the boy and the girl are ready, but custom and expedience say "Wait," may be the years of greatest strain.

A stranger to Western civilization might imagine that having legally retarded, with good reason, the age of consent, and traditionally the age of marriage, we should take especial pains at home and at school to instruct young persons in the nature and extent of the responsibilities upon which presently they are to enter. Little of the sort takes place. In some centers, we find sporadic efforts to teach the young about sex organs, sex behavior, children, family life, and mental hygiene, but they are exceptional.

In every high-school classroom, the young are trying better to understand themselves and their fellow pupils, and to enter zestfully into the strange world that is dominated by adults. Except to the modern spirit, not unknown in centuries past, it suffices to give them more of the fragmented facts and principles that have characterized their elementary-school days. Nobody would relish stopping the programs devoted to reading, science, and the arts. Fortunately we are not faced with an either-or, but with a need for perspective and balance. The child who has solved some of his major personal problems, who is beginning to find himself in the world, is a better thinker — a better doer of intellectual tasks. What he needs is a reasonable amount of help nicely timed to the appearance of obstacles, frustrations, and obscurities. Much of it will come from siblings, companions, and parents, from his medical and religious advisers, but he is still a student in a classroom for most of the day, and in this milieu he is accustomed to learn new things and to get new light.

Some previous observations of mine may be cited; emotional instability is a problem that is not peculiar to the onset of pubescence, although it may be aggravated at that time:

> . . . the emotional health of children does not depend upon the elimination of emotional responses. Too often the so-called "discipline" of the school leads one to suspect that the only aim the teacher has in mind with respect to the feelings and emotions of her class is a completely inhuman negation of all such responses. Clinical experience indicates that such attempts at restriction and repression will be harmful to the child. One obvious and common way by which the child circumvents such attempts is to make up for his enforced silence by excessive rebelliousness or withdrawal. Too often the result is a special problem in mental hygiene which need not have existed.

> The golden mean of emotional response then does not lie at the point of no upsets, no exercise of strong emotions. Neither does it lie in frequent excesses. As the child grows older, strong emotional responses to trivialities, to slight frustrations or uncertainties, indicate the need for psychiatric attention. Rebelliousness carried to an extreme may lead to delinquencies, and in its final form, as Wickman has indicated, to murder. Extreme withdrawal is just as bad, for it may indicate the onset of various psychopathies of which *dementia praecox* is the most formidable. The child may withdraw so much into himself and be so unaffected by external stimuli that he cannot be "reached." Should he wake up sufficiently to discover a complete disjunction between his imagined or desired world and the world about him, he may achieve the most effective retreat of all — suicide. (pp. 164-165.)[1]

Lawton[2] has illustrated the type of questions that absorb the mental life of boys and girls within the general adolescent period from fourteen to eighteen years of age. His statistics are based on 990 questions asked by 385 boys and girls. There is a disjunction between these topics (the ones most frequently mentioned by the pupils) and the standard high-school class discussions: "Love, God, Death, Criticisms of people in general, Life, Future, The hereafter, Religion, Reincarnation, The end of the world." The chief unanswered questions of this particular adolescent group lay in human nature, religion and philosophy, science, and sex, in the order indicated. Since any procedure that encourages blue-sky questions will bring out problems that are personal, dramatic, and frustrating, we need not regard the responses as representative of the total mental content. If they were to be emphasized to the extent of slighting work in general education, we should then expect questions in the latter area to predominate. The only suggestion for school people is that, by a tacit disregard of the special interests of young persons, they make the whole curriculum appear elementary or unrealistic. The gifted boy, working steadily toward a reasonable goal, let us say to become a first-rate mathematician, is not immune from the social and philosophical demands of the time: in all respects except the diligent pursuit of mathematics, his needs and hopes are the same as those of other pupils. No mastery of his chosen field will make up for deficiencies in a knowledge of human nature, society, government, and philosophy. The aim of general education in grade school, high school, and college is to turn out the citizen-farmer, the citizen-worker, the citizen-businessman, and the like, the good citizen being defined negatively as one who keeps out of jails, asylums, and similar institutions, and positively, as one who serves well the stated ends of society.

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[1] Stoddard, George D.: Guiding the Emotional Health of School Children. *Educational Method*, 1935, 14, 163-166.

[2] Lawton, George: *A Preliminary Study of Questions Which Adolescents Find Unanswerable.* Paper delivered at one of the Educational Research Symposia of the High School Teachers and High School Principals Association, February 26, 1938. Pp. 10.

BEHAVIOR AND ADJUSTMENT

For present-day conditions among selected American students in a large university, the conditions listed below have been reported as the major sources of emotional upset in the adolescent and postadolescent years. The categories are not well defined, and they are not to be thought of as the "true causes" of maladjustment or of interference with the intellectual process; rather, they are what groups of upperclassmen have regarded as the chief plagues of their lives.

(1) A complex pattern of forces within the family: (*a*) a broken home; (*b*) parental oversolicitousness; (*c*) parental domination; (*d*) severe family tensions; (*e*) chronic illness, intoxication, or drug addiction in the family; (*f*) conflicting ideologies as between children and parents (expressed in criticism, restriction, or indifference).

(2) Physical handicaps, peculiarities, and diseases. (The frequent mention of this type of conflict lends validity to Adler's emphasis upon it as a major source of the "inferiority complex.")

(3) Economic handicap.

(4) Minority group handicap, as in race, religion, or nationality.

(5) Miscellaneous factors, as in real or assumed mental retardation, abnormality, persecution, and gang influence.

Since our concern is with the development of intelligence, it is not necessary to assemble clinical and psychiatric evidence in support of these manifestations, nor to relate them to the standard nomenclature and symptomatology of abnormal psychology. No normal child is entirely free from these troubles. It would be hard to demonstrate that in their milder stages they interfered at all with the development of the highest abstract and original abilities. Up to a point, they may aggravate the drive toward intellectual and artistic accomplishment. Unfortunately some teachers and parents cannot distinguish between the slight flick of a whip and a merciless beating, or refrain from a bitter sarcasm designed less to guide a young person than to "keep him in his place." It is axiomatic that every school child somewhere in his career will need friendly counsel along lines that are not strictly curricular. To be helpful at such times is to enable the child to learn more, to behave better, and to grow more surely toward the high aims of democratic education.

A clinical study that stands out from the others, in that it attempted to find the basis for *good* adjustment among high-school students, was carried on by Thom and his associates.[1] Recognizing that many factors (such as those reported for university students) were contributing to maladjustments of personality and behavior, they were nevertheless unable to establish the converse, namely that children brought up under favorable circumstances would all be well adjusted and happy. Within each child there is a unique convergence of constitutional and environmental factors that enables him to react differentially to social stimulation. Of the exceptional pupils who are not easily bracketed, Thom *et al.* have this to say:

> The most interesting and perhaps most important cases were those who, although belonging definitely to the dull normal group, were able to put themselves across even under fairly severe competition. Notwithstanding the fact that the objective of our study was to determine the factors, both inherent and environmental that contributed to a personality make-up that was capable of adjusting to the varied situations and problems of life as they are normally presented, we are still begging for an answer. It is true that in a general way there is a direct relationship between environment (social, economic, cultural) and the human product as evaluated by the criteria applied by the social group. Poverty, ignorance, immorality breed delinquency and criminality, while economic security, wisdom, morality breed, in a general way, an individual who is more likely to be a conformer, more efficient, and probably happier. The exceptions as indicated still present a problem which

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[1] Thom, Douglas A., Spencer, Harvey, Berk, Arthur, *et al.*: A Study of One Hundred and Twenty Well-Adjusted High School Students. *Bulletin of the Massachusetts Department of Mental Diseases*, 1936, 20, pp. 106.

> should issue a challenge to sociologist and psychiatrist, for herein may lie the answer to many of life's tragedies as witnessed in the home, court, and clinic. (p. 92.)

All the school can hope to do is to bring to bear upon each child, in a kind of friendly focus, the established principles of mental hygiene. While this will not eliminate behavior problems and school failures, it should reduce them, particularly if supported by parental cooperation. In this respect, the Fifteenth Yearbook of the Department of Elementary School Principals in the National Education Association[1] may be considered a major advance in the thinking of educators. It recognized explicitly that problems of behavior and adjustment are central in the program of the public school.

Regardless of the grand scheme by which schools and school systems are organized, the focal point of contact is the classroom teacher. Any reforms in administration, finance, or curriculum that leave her out of account are headed for deterioration and futility. Aided by supervisors, the teacher can make an intellectual pesthouse out of a limestone castle, or transform the simplest of buildings into a place of serenity, growth, and enlightenment. We are not faced with a dichotomous choice as between good school buildings and good teachers, but quite the reverse: in the long run, all good things go together. Good administration is sensitive alike to plant efficiency and classroom excellence.

THE ROLE OF THE TEACHER

The teacher's main contribution is more than the application of a standard methodology to a group of pupils. What she is herself, what she likes, what she wants her pupils to be, for better or for worse, will be revealed to the children, and will condition their responses. Lacking personal adjustment, the teacher can be a source of contagion:

> While it is not clear that the teachers as a group are more subject to special maladjustments than other people, it is certainly clear they are not free from the neurotic and psychotic tendencies which afflict people generally. In short, there has been no consistently

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[1] The National Elementary Principal: *Personality Adjustment of the Elementary-School Child.* Fifteenth Yearbook of the Department of Elementary School Principals, National Education Association, 1936, 15, No. 6, 227–672.

> successful effort to eliminate from our school systems teachers who, though competent along strictly academic lines, can be shown to be thoroughly unstable in personality. Nor has there been any systematic effort so to organize schools as to make them conducive to the highest personal adjustment of the teachers involved.
>
> That unstable personalities in school-teachers will affect the adjustment and behavior of the pupils with whom they are thrown into constant contact is supported by substantial, objective evidence. It is moreover consistent with what is known generally about the effect of one person upon another. Teachers do not work in an emotional vacuum. Their maladjustments — their fears, obsessions, hates, and inferiorities — are real and potent in their influence upon pupils. As a rule such influence is measured by indirect means. (p. 88.)[1]

In short, the limits of what any person, under the best of circumstances, can do for another person are obscured by a scarcity of examples that combine the highest motives with modern psychological insight, and further by the difficulty of fitting words to responses that are nonverbal in character.

EDUCATION AT HOME AND AT SCHOOL

This is not the place to present a systematic program for American education; my concern rather is for such theories, plans, and aims as will safeguard and bring to full maturity the enormous growth potentialities of children. Mechanized and transformed as the modern world has become, the simple fact remains — the first intellectual growth is parent-stimulated and parent-sponsored:

> In these early preschool days, education consists essentially in providing the opportunities for motor and linguistic development. A child, for example, can be so discouraged in his first attempts to creep or walk that the process is definitely retarded. He may, on the other hand, be so encouraged as to undertake motor activities usually considered out of line or abnormal for infants. Thus, with appropriate training such complex skills as roller skating, swimming, dancing, and acrobatics may be added to the child's repertoire shortly after he is able to walk.
>
> Since schools are being extended downward to include children as young as two years, it is becoming more important for teachers

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[1] Stoddard, George D.: The Teacher as a Person [In] Kilpatrick, William H. [Editor]: *The Teacher and Society* (First Yearbook of the John Dewey Society). New York: D. Appleton-Century Company, Inc., 1937. Pp. vi, 360. (pp. 68–92.)

> to be aware of these earliest conditions and factors in child education. As a matter of fact, much of what goes on in the earliest infant days will be repeated more elaborately and more subtly up through the school years. (pp. 422–423.)[1]

In America, everybody has long agreed that by the time a child reaches the age of six years, the parents need help. Intellectually the child is now too much for its mother: her own residual knowledge of the three R's, ranging from the rudimentary to the professional, does not carry with it materials and techniques suitable to pedagogy. With no change whatever in theory, but armed with a new knowledge of the range of individual differences, millions of parents now demand for their children the advantage of public schooling at five, with a possible extension downward to four years. But there have been changes in theory and practice, too, as often initiated by discerning parents as by educational authorities. At all grade levels, there is a strong movement to regard the child as more than a learner of the lean curriculum and to enlarge the school's major offerings by paying attention to health, character, adjustment, vocational fitness, and citizenship. Meanwhile the central core of learning expands to include a dozen scientific and cultural fields.

The Nursery School

Much that is found in new schools for six-year-olds or twelve-year-olds looks good, in principle, for two-, three-, and four-year-olds. In the past thirteen years the following statements, originally offered as postulates, have become firmly established on the basis of research. (See, for example, compilations by the National Association for Nursery Education.[2,3])

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[1] Stoddard, George D.: Contributions to Education of Scientific Knowledge About Mental Growth and Development. The Thirty-Seventh Yearbook of the National Society for the Study of Education. Part II. *The Scientific Movement in Education.* Bloomington, Ill.: Public School Publishing Company, 1938. Pp. xii, 529. (pp. 421–434.)

[2] Bradbury, Dorothy E., Skeels, Esther Leech, and Swieda, Wanda: *Nursery School Education: A Classified and Annotated Bibliography Including References Published up to December, 1934.* Iowa City, Iowa: National Association for Nursery Education Distribution Center, 1935. Pp. vi, 133.

[3] Bradbury, Dorothy E., and Skeels, Esther Leech: *A Bibliography of Nursery School Education, 1935–1939.* Iowa City, Iowa: National Association for Nursery Education Distribution Center, 1939. Pp. iv, 64.

> 1. The pre-school (nursery school) provides desirable play facilities, such as good toys and apparatus, playground, fresh air, sunshine, etc.
>
> 2. The pre-school, through its studies in nutrition and its nurses in the service, can in part provide and in part recommend the proper diet for each child.
>
> 3. The pre-school is right in building up early social contacts among children of the same age.
>
> 4. The pre-school is favorably organized to improve habits of dressing, eating, playing, sleeping, learning, singing, etc.
>
> 5. The pre-school is favorably organized to discover in incipient stages and to modify successfully bad behavior patterns, such as negativism, fears, enuresis, etc.; and through its psychological workers to contribute generally to the mental hygiene of the child.
>
> 6. The pre-school environment is favorable to mental development.
>
> 7. The pre-school provides a gradual introduction to the more purposeful activities of life, so that entrance to kindergarten or grade one does not constitute a strong break.
>
> 8. The pre-school reduces the likelihood of harmful coddling on the part of an indulgent mother.
>
> 9. The children like to go to pre-school.
>
> 10. The children's reaction to home life is favorably affected by life in the pre-school.
>
> 11. Desirable behavior patterns, if built up in the pre-school, tend to transfer to the home and community life of the child.
>
> 12. The public school assumption of responsibility for the type of pre-school represented in various universities would, on the whole, improve the status of childhood by insuring tenure, financial support, professional standing and universality. (pp. 586–587.) [1]

Not all nursery schools, under all conditions, will produce such outcomes. Like other schools, they can be so badly conceived and sleazily maintained as to run counter to good educational practice. The question is, When they are good, what is their source of strength; by what device or principle do they truly contribute to the child's development? This I have attempted to summarize elsewhere, as follows: [2]

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[1] Stoddard, George D.: Extending the Schools Downward. *Educational Administration and Supervision*, 1929, 15, 581–592.

[2] Stoddard, George D.: What of the Nursery School? *Progressive Education*, 1937, 14, 441–451.

> . . . some of the centers of greatest ferment are found in regions hitherto considered unpromising. Thus, Dr. Grace Langdon, in charge of WPA nursery schools, writes after a trip through underprivileged regions in five southern states: "It would have thrilled you as it did me to hear the things that these people said about the nursery schools. Mayor after mayor said to me in effect, 'The whole town is better because of these nursery schools.' School superintendents told how they felt the school in general had benefited because of the nursery schools. One pediatrician told me he could tell a nursery school child anywhere and how he wished all the children could go. One woman said, 'I can love 'em a lot when they ain't under foot all day.' Another told me how she would have to change things at home because 'her little kid wouldn't eat no more without settin' down.'"
>
> In these areas the nursery school movement is regarded fundamentally for just what it is: a folk movement springing up from deeply felt but long-neglected needs on the part of the great mass of mothers and fathers who, having children, want to do well by them. And in this they are right, even from the standpoint of purely selfish motivation; for their children's lives are their lives, too, and what enriches the one, enriches the other. . . .
>
> Education, by its very nature, goes on under all conditions. It does not require a home, a school, a church, or an institution. It is only when we state that the *aims* of education set up certain requirements in physique, mentality, personality and behavior that special forms and methods of social organization are clearly indicated. It follows that so long as we want a good life for the young child, a life upon which subsequent growth and activity may be securely founded, we shall have to do more than rule the child by out-of-date, never-understood methods. (pp. 447–450.)

That research outcome, parental approval, and the psychologist's favorable attitude imply an immediate wholesale acceptance of the nursery-school idea, would of course be far from the truth. We can expect nursery schools on a nation-wide scale only when three great columns of social change converge upon the problem; in truth, what was once a post-depression opportunity has become an after-the-victory dream:

> Now nursery education appears upon the economic scene. It is a new frontier. It may be expected to grow into a tremendous enterprise. At the preschool level, we have several million potential consumers of new social and material goods. We propose to give them better nourishment, better medical attention, more space, more toys, more materials, more expert guidance (both at home

> and at school) than they have ever had before. We expect to house these children in buildings which are appropriate and beautiful; to give back to them the essential elements of free space, fresh air, sunlight and child companions. (p. 51.)[1]

But the nursery school cannot be evoked purely in terms of economic enterprise; it demands the relinquishment of family prejudice and professional complacency. In a successful movement the two columns of economic soundness and parental need must be joined by the forces of public education.

We can envisage a fourth column in the change-over of conservative business or government from an economy of dollars to an economy of man-hours and services rendered, and a "fifth column," if there is to be one, recruited from those brigades that resist reform, not on the merits of the case, but in the belief that all change is for the worse. These matters involve schisms that, except in the urgencies of financial collapse or wartime effort, divide society into Neapolitan slices. They are not a monopoly of education — they appear in every vocation, political party, nationality, and religious sect.

The Children's Charter

How *radical* the nursery-school idea really is can be gleaned from its calm inclusion as point number 8 in the Children's Charter of Hoover's White House Conference on Child Health and Protection.[2] (The White House Conference of 1940[3] went no further; in relation to changed conditions, it lost ground.) An abridged version of the nineteen points in the Children's Charter follows:

1. For every child spiritual and moral training to help him stand firm under the pressure of life.
2. For every child understanding and the guarding of his personality as his most precious right.

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[1] Stoddard, George D.: The Nursery School as an Economic Enterprise. *School and Society*, 1936, 43, 49–51.

[2] *White House Conference on Child Health and Protection:* Addresses and Abstracts of Committee Reports, 1930. New York: D. Appleton-Century Company, Inc., 1931. Pp. xi, 365.

[3] *Proceedings of the White House Conference on Children in a Democracy.* U. S. Dept. of Labor, Children's Bureau, Pub. No. 266. Washington, D. C.: Government Printing Office, 1940. Pp. iv, 85.

3. For every child a home, and for the child who may not receive foster care, the nearest substitute for his own home.
4. For every child full preparation for his birth.
5. For every child medical, dental, and nutritional protection from birth through adolescence.
6. For every child wholesome physical and mental recreation.
7. For every child a dwelling place safe, sanitary, wholesome, and esthetic.
8. For every child a well-equipped school; for young children nursery schools and kindergartens to supplement home care.
9. For every child a community which provides him with safe and wholesome places for play and recreation.
10. For every child an education which, through the discovery and development of his individual abilities, prepares him for life; and through training and vocational guidance prepares him for a living which will yield him the maximum of satisfaction.
11. For every child such teaching and training as will prepare him for successful parenthood, homemaking, and the rights of citizenship; and, for parents, supplementary training to fit them to deal wisely with the problems of parenthood.
12. For every child education for safety and protection against accidents.
13. For every child who is blind, deaf, crippled or otherwise physically handicapped, and for the child who is mentally handicapped, appropriate measures to reduce his handicap and training to become a useful member of society.
14. For every child who is in conflict with society the right to be dealt with intelligently as society's charge.
15. For every child the right to grow up in a family with an adequate standard of living and the security of a stable income.
16. For every child protection against labor that stunts growth either physical or mental, that limits education, that deprives children of the right of comradeship, of play, and of joy.
17. For every rural child privileges equal to the city child.
18. As a supplement to the home and the school encouragement of voluntary youth organizations.
19. The setting up of such public and administrative bodies as shall be necessary to make all these eighteen points really effective to every child regardless of race or color or situation and within the shortest period of time.

GENERAL EDUCATION

As we move up through the well-established grades, the logic of general education requires little modification of the indicated experiences for the preschool child. The general intellectual framework, upon which so much specialized data and knowledge will ultimately depend, consists of a common coinage in language, symbols, and numbers, in the sciences, arts, and humanities — all to be given form and meaning in terms of the child's here-and-now experience. Programs that overlook the child himself are sure to be weak and fitful — the vague pulsing of a world apart, never jolting him into a sense of need.

Knowledge indiscriminately gathered in for its own sake has no place in our concept of intelligence-at-work, nor is it, according to Einstein,[1] to be highly regarded as a preparation for life:

> I want to oppose the idea that the school has to teach directly that special knowledge and those accomplishments which one has to use later directly in life. The demands of life are much too manifold to let such a specialized training in school appear possible. Apart from that, it seems to me, moreover, objectionable to treat the individual like a dead tool. The school should always have as its aim that the young man leave it as a harmonious personality, not as a specialist. This in my opinion is true in a certain sense even for technical schools, whose students will devote themselves to a quite definite profession. The development of general ability for independent thinking and judgment should always be placed foremost, not the acquisition of special knowledge. If a person masters the fundamentals of his subject and has learned to think and work independently, he will surely find his way and besides will better be able to adapt himself to progress and changes than the person whose training principally consists in the acquiring of detailed knowledge. (p. 47.)

A practical proposal comes to mind, namely to apply to the measurement of all-round pupil growth certain procedures previously advocated for the improvement of intelligence testing. Let us assume that every effort has been made to provide superior school experiences, taking into account the full resources of home and community. Whatever the curriculum and the motivation, however high the standards of accomplishment, we shall discover fundamental differences in human ability and progress. This hypothetical school system would attempt to secure not uniformity, but a common denominator of learning, behavior, and social adequacy, beyond which pupils would be granted the privilege of wide variability, both outward and upward. The upward extension would be under the guidance of the finest teachers, who would devote to it the exquisite care of a Mill or a Montaigne.

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[1] Einstein, Albert: Some Thoughts Concerning Education. [In] Proceedings of the Seventy-Second Convocation of the University of the State of New York. *University of the State of New York Bulletin*, 1936, No. 1100, pp. 50. (pp. 43-47.)

In this system, the cumulative record would go far beyond present-day reports in which test scores are imbedded like gravel in a soft substratum of personal history; it would comprise these evidential materials:

(1) Diagnostic tests to serve as a map of the main curricular elements.
(2) Knowledge tests to tap the highest level of understanding and accomplishment in various fields.
(3) Growth in knowledge under controlled conditions of learning and motivation.
(4) Growth in knowledge under free or contract conditions (with a liberal time allowance).
(5) Growth in knowledge under conditions of distortion and propaganda.
(6) Evidence of aptitude, originality, or unusual devotion.
(7) Classroom and clinical observations of personality, adjustment, and character, with case materials, together with notations concerning health and home life.

The items numbered 2, 3, 4, 5, and 6, above, call for new testing procedures not dissimilar to the demands inherent in our definition of intelligence. *Any teacher in possession of a pupil dossier expertly prepared along these lines will have little need for "intelligence tests" as currently marketed.* This kind of exact and intimate record is a trust as private as a medical history or a religious communication; it could lead to the abuse so poignantly described in du Gard's *The Thibaults.* It should be made available only to a teaching staff thoroughly trained in its use, and tested as to loyalty and good will.

Since education is all-pervasive, the *educator* at work on many fronts, including many persons who would be diffident about the appellation, should give some thought to the nonprofessional, noninstitutional areas of human thought and action. Any form of hitlerism anywhere will destroy him and his works, to the confusion and degradation of children entrusted to his care. Useful things can be accomplished during a war, for military efficiency is consistent, up to a point, with physical and mental fitness; its major departure consists of a dislocation of events as between *urgent* and *long-run.* Hence there is a necessity for long-range planning during the grimmest of days.

Educators should set out to achieve educational goals for all persons from birth to senescence, granting that such ends may require economic and social reconstruction. The goals can be built around such concepts as general knowledge, health, behavior, vocation, citizenship, mental hygiene, recreation, and the fine arts — in short, the *good life;* they imply mother-infant protection, preschool education, elementary-secondary education, college education, adult and parent education. From the standpoint of plant and equipment they call for homes, schools, libraries, museums, recreation centers, and facilities for travel. They call for a highly selected and well-paid teaching, supervisory, and executive staff, indicative of the prime place of education in any democratic society.

Education is making tremendous contributions to the wartime effort. In the long, dark years ahead, it will be called upon to stamp in the victory and assist in a return to peacetime conditions. It will be expected to train the young and the old, and to furnish a great outlet for labor and the products of labor. As one of America's biggest enterprises, it must be prepared to take giant strides in behalf of an economic reconstruction that is consistent with the needs of childhood and youth. Education should be neither wasteful nor bashful. The general social responsibility of educators, now and in the long run, is to work shoulder to shoulder with persons in every productive field. They must show expressly *for what purpose* they demand reforms, with the expectation that workers in other fields will do likewise. In the aggregate, educational proposals and programs will play a major role in the postvictory planning, but legislative counseling on the part of educators, which should clarify issues and unite all persons and forces in behalf of the young, has been thus far somewhat mixed.

The new and green pastures available for American higher education are fairly easy to discern:

> Out on the periphery of most colleges, but squarely in the center of modern life, we find such phenomena as child development, nursery education, the kindergarten, adult and parent education, public health, mental hygiene, social administration, speech correction, remedial reading, radio, and the fine arts. To these may be added recreation in its professional aspects and new outlets in public administration. Moreover old vocations are available to college graduates, as they were previously to high school graduates. The man who fills your car with gas is a high school graduate; the livery stable attendants of the previous generation almost never were. The farmer's son knows a world closed to the farmer himself. Science, music, literature, economics, history, foreign language — he has dabbled in some, and become really proficient in a few. The highly selected, thoroughly trained policeman of tomorrow, expert in crime prevention and detection, and informed in the law, will need four years of college, and a few will even go on to the Ph.D. degree. The modern woman, to be expert in the modern home, will need to know her way around in many of the fields represented in standard college catalogues. Child development, nutrition, economics, psychology, fine arts, and the humanities — she will need them all.
>
> Without recourse to such matters, it becomes increasingly difficult to maintain a sense of reality in our collegiate programs. The serious occupations of present-day life are as collegiate, let us say, as the French Revolution, or the poems of Tennyson, or the elements of chemistry. They may be so set up, with a full demand upon laboratory, library, studio, research, and scholarship as to rival, in a strictly academic sense, the older subject matter. (pp. 206–207.)[1]

The American Youth Commission

Forward-looking in its recommendations and clear in its voice is the American Youth Commission of the American Council on Education, whose definitive publication entitled *Youth and the Future*[2] is a document of genuine social importance. In the introduction, Owen D. Young reports the Commission's general assumptions:

> 1. That the successful prosecution of the war is the most important problem confronting the American people today.
>
> 2. That in the post-war period, economic reconstruction to achieve sustained full employment under peacetime conditions

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[1] Stoddard, George D.: The Arts College and Contemporary Life. *Bulletin of the Association of American Colleges*, 1939, 25, 204–212.

[2] American Youth Commission: *Youth and the Future.* Washington, D. C.: American Council on Education, 1942. Pp. xix, 296.

will be the most difficult problem and the most urgent objective of the American people.

3. That the changes in the basic structure of the American economic system which have taken place during the last fifty years, and which in some cases are now being accelerated, will not present insuperable barriers to the achievement of peacetime full employment but will undoubtedly make necessary many fundamental readjustments.

4. That for some years after the war, efforts to achieve sustained peacetime full employment through the expansion of private employment will be only partially successful, and that meanwhile it will be necessary to carry on substantial programs of public work for the unemployed.

5. That because of necessity the trend both during and after the war will continue toward an increasing use of government to regulate economic affairs and in particular that government will be given increasing responsibility for the peacetime stimulation of a balanced expansion of productive activity in the basic industries producing for interstate commerce.

6. That under democratic government and without giving up the liberties we prize, the American people will have it within their power to bring about a continuing abundance of available employment opportunity in future times of peace, with a rising standard of living for all who contribute to the productive effort of the nation.

In stating these assumptions, the Commission does not assume either that we are completely at the mercy of fate or that we shall reach our desired goals without sacrifice and effort. It is assumed that the American people will continue to exercise their native qualities of good will, courage, and foresight, and that progress will thus continue toward the realization of the American dream of universal opportunity in a land of peace and freedom. (pp xiv–xv.)

The Youth Problem

But the evidence of other views and other campaigns is everywhere at hand. Ryan [1] points it up:

> In all the attempts to explain why Mr. Roosevelt has not come forth with a resounding acceptance of the Federal Education Bill it seems to me one important consideration has been overlooked. Is it possible that he is not enthusiastic for certain kinds of formal schooling and does not care to see them multiplied unduly? Is he more interested in kinds of youth education, for example, that

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[1] Ryan, W. Carson: Has Vision Been Lacking? An Explanation of Why No Federal Aid. *Frontiers of Democracy*, 1941, 7, 138–141.

> attempt to meet the needs of youth instead of perpetuating an outworn type of academic high school? I should like to suggest, as part of the explanation, this: *That the President, like many of the rest of us, is deeply interested in education, but wants to be sure that it's the right kind of education.*
>
> To what extent will the history of the Federal Office of Education and our efforts as educators in behalf of a Federal program reassure him on this point? Not too well, I would say. Did not some of our representatives in Washington oppose a combination of education with health and welfare when reorganization recommendations suggested that this would be desirable? Have we any but ourselves to blame if as educational workers we insist upon so narrow a concept of education that we decline to join forces with those agencies that are doing a vast part of the educational work of the Nation — *educational* in the fundamental sense, I mean? I have heard a variety of versions of White House discussions on this particular matter; but one point on which they all seem to agree is that the school representatives certainly did not make any too clear their willingness to team up with health, social work, and other groups interested in the development of human beings. (p. 141.)

There is a growing body of evidence that educational leaders over the country are quite willing to accept their share of responsibility in forwarding youth education — and to worry less about the old bugaboo of jurisdiction. If I were allowed to cast a stone, I should say that a person is a community is a state is a country. No amount of money, political power, or protective alliance can guarantee the reform that the times demand; for schools as for persons, the final victory comes from within. We must be prepared for the day when power is granted; we must know, as never before, what kind of education is contemplated — what kind of a world we want. There is a difference of opinion, but no essential disunity that cannot be dissolved in the hot years of this decade.

Breed,[1] in a light dialogue, touches on matters that weigh heavily upon higher educators:

> Common to the various forms of positivism, says [Mortimer J.] Adler, is an affirmation of science and a denial of philosophy and religion.
>
> Not a denial of philosophy and religion, but of your definitions, answer the professors who believe in philosophy as one with science in both method and basic material.

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[1] Breed, Frederick S.: Modernism Versus Medievalism. *School and Society,* 1941, 53, 153–154

> Knowledge is of two kinds, natural and supernatural, says Mr. Adler.
>
> Supernatural? inquire the professors with lifted eyebrows. Prove it.
>
> Knowledge is of two kinds, relative and absolute, says Mr. Adler.
>
> Absolute? query the professorial skeptics. Let's have a sample.
>
> Values transcend science, says Mr. Adler.
>
> No, even values are grist for the mills of science as well as of the gods, respond the recalcitrant professors, with a glint of empirical dogmatism in their eyes.
>
> Every student who has taken as much as an introductory course in philosophy should recognize this argument as something not altogether new, as having much in common with philosophic disputation at the turn of the century, when William James went forth to do battle with the fearsome Goliath of absolute idealism, and put an irreparable dent in his head with no more formidable weapon than a despised empirical slingshot. Later, during the generation that followed, empiricism invaded the most hidden recesses of philosophy, as Adler implies.
>
> But this does not mean that Mr. Adler is not a voice crying in the wilderness. Forget his scholasticism, his supernaturalism, and he still remains a prophet of disaster that will overtake a divisive individualism, a flabby liberalism and an impotent skepticism. He appears to be saying the hour of decision has arrived: one can not build a program of education on the right to doubt, one must also believe. (p. 154.)

Day,[1] in a forthright peroration, dwells upon the spiritual values everywhere sought:

> Free men are men of good will. They know that hatred *of men* rather than *of evil* is a devastating passion in human affairs. Free men avoid malice and envy as they would poison. They are devoted to justice, sensitive to human needs and aspirations, considerate of their fellow men. (p. 9.)

How the religious spirit may live and be helpful in a science-dominated world, has been suggested by Allport:[2]

> It is the function of religion, therefore, to assume the task where science must leave it. Hand in hand the two have run their course;

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[1] Day, Edmund Ezra: *The Discipline of Free Men.* Ithaca, N. Y.: Cornell University, 1941. Pp. 12.

[2] Allport, Floyd Henry: *Institutional Behavior: Essays Toward a Re-Interpreting of Contemporary Social Organization.* Chapel Hill, N. C.: University of North Carolina Press, 1933. Pp. xiii, 526.

> but science comes to an end, and beyond its outposts stands faith. Now he who makes this answer, if he makes it sincerely, must be willing to put it to the test. If "religion" is to be a cohort and not an enemy of "science," a religionist must be ready to go patiently with the scientists, step by step, to the borders of our present known universe. Before donning his superscientific spectacles, he must see intimately what Pasteur, Maxwell, and Einstein have seen. Appreciating their view, he must then build an extension logically and coherently related to the structure they have reared. And a true scientist, on his part, would welcome the whole-souled aid of such a faith. Serving as an extension at the end of his microscope and his telescope, it would reveal the deeper realities of the things before him. (p. 457.)

THE LIMITS OF EDUCATION

Since not every student, professor, or college president can live in this rarefied atmosphere, we are brought down and around to the perennial question implied in any discussion of school-aroused intelligence, from preschool to college: *What are the limits of education?*

As we know, the first limit that everybody thinks of is that of heredity. Children may be born with organisms so defective as to render hopeless any adequate solution of personal and social problems that are sure to arise. All students of science admit at once that this is sometimes true. Fortunately such cases comprise only a small fraction of the population, and they can be discovered early.

Above this deeply feeble-minded group, there is a much larger one whose limits of education, along strictly academic lines, are approached somewhere in the public-school system. They drop out at various levels (unless kept in by a compulsory school law). not so much because they can no longer profit by schooling, as that the particular offerings of schools are for them inappropriate. True, they do not want to go in for higher English or higher mathematics, but a wholehearted development of the simpler arts and crafts, together with the elements of science and literature, would be acceptable.

In America, most adolescents and many adults are still in school. High school, college, and university draw out from the great army of children not a chosen few, but a high percentage. In the Middle West, for example, from 30 to 40 per cent of all high-school graduates go to college. Nor do colleges draw mainly from the upper level of high-school excellence; they tend to get as freshmen a cross section of the senior class of the secondary schools. These two factors give us a new perspective of the educational task involved. The principle of equality of opportunity in education has led to one of the greatest cultural experiments ever undertaken by the human race.

Just how far will the hereditary limits imposed on human beings permit us to go? Of this we can be sure: the possibilities for human development through educative means are far greater than our ancestors supposed. Nowhere, from Plato to Rousseau, was there any convincing argument to show that the great mass of people could be taught to read and write. Until the Civil War, there were no high schools and not many private secondary schools in the whole United States.

With the rapid expansion of schools and colleges, a great paradox came to light, predicted by the few, but puzzling to the many: the more the schooling, the greater the production of economic goods. Colleges taught young persons better ways of farming, mining, and manufacturing; they directed a flood of mental energy into the professions; they helped to build systems of transportation and communication; they developed a salesmanship which seemed to increase the wants of mankind. They were not equally capable of turning out graduates sensitized to social welfare, and to ways by which communities could work toward it without sacrificing the dearly won victory for individual enterprise. Nor was there anything in world-wide education sufficiently potent to prevent economic collapse and war.

Is this one of the limits of education brought with us at birth — this terrible inability to solve problems beyond the scope of the individual mind — this utter lack of a controlling and integrating skill applicable to the whole world? A few years ago several hundred members of the American Psychological Association were asked if they believed that man has an inborn and ineradicable tendency to make war. The psychologists were almost unanimous in denying any such instinct. War expresses a limitation, not so much to individual capacity as to social organization. I have chosen war as a prime example, but others would serve almost as well. The evidence is slowly accumulating that the stagnating and degenerating areas of the world exist only because of a shortage of good will and effective organization. There are forces available to scientists, physicians, and educators, to political, social, and religious workers, which if used widely, as they already have been used in isolated circumstances, would bring peace and plenty upon this earth.

For example, in America the specter of economic underproduction could be laid; the majority of diseases could be reduced to a negligible factor, by well-known methods of prevention and therapy; our national life could be rejuvenated by an acceptance of fundamental changes agreed upon by the most diverse political thinkers. Our leading workers have charted clearly the way to reduce delinquency and crime. There remains the great group of psychopathies, the mental ailments of every description; here modern methods in mental hygiene and psychiatry at least offer hope.

The implication is that we must achieve both a high degree of individual efficiency and a mastery of social technique. Great cooperative enterprises will be in part a function of private mental capacity; we must, as John Dewey says, learn to think alone, but to work with others.

In a world out of joint, I hesitate to speak of religion at all, except along the lines of escape. Nevertheless, personal integration is consistent with (and for many, dependent upon) the deeper permanent aspects of religious life. Religion, like education, is concerned with the quality and worth of human beings, of the individual conceived as a person and not as a pawn to be played. Both have to do with the brotherhood of man, even though some men must be destroyed, their ideas pushed down and back, that living men may again be free. We are all concerned with peace and good will, though there is no peace. Practically, the arts of feeding, of healing, of learning, of family life, of the improvement of farms and homes and cities partake of the nature of a life eternal. Such prospects are realized in the long view, not the short: there is a kind of biological survival from generation to generation that is not denied to us, a linkage that is independent of particular theological beliefs or mystical aspirations.

In perilous times, above all, we need the strength that comes from working and sharing; we need it to win the war and the peace that follows. As a counterattack upon drabness and superficiality, we need persons, objects, and scenes that are familiar and beautiful. We must not make the mistake of the New England Puritans who, for the sake of a narrowly conceived morality, deprived themselves of the wellsprings of human zest and hope. They sought goodness and lost happiness; they preached a life to come, but became hard, dreary, and sadistic among themselves. In a world grown tough, Americans are peculiarly fitted to retain a note of gaiety — a glimpse of heaven that springs from insight and participation. Sacrifices already piling up against us can make our present condition appear as a mirage of luxurious living. The four horsemen are riding the earth again, devastating the land. Every person is afflicted by conditions that intensify not only his own little troubles, but those of all his fellow men; we are feeling a world pinch.

It is crystal-clear that, among the stern limits to the process of education, a goodly number are self-imposed, either by the individual or by the society which he helps to create. It follows that the real key to service and happiness as ends of education lies within ourselves. What we cannot by single or cooperative effort improve, we can at least adjust to. The limits that we set are seriously below those that nature necessitates.

CHAPTER XVI

SOCIAL IMPLICATIONS

All educational implications are social, and the reverse proposition is not untenable. Man lives and grows by learning, by a process of self-education continuous from birth to death. In the last few centuries, for a small percentage of the world population, during a brief period of childhood, and in restricted areas of information, there have been established schools designed to supplement the teachings of family, gang, guild, job, club, church, and state. Still, even in the best of countries, the school has hardly kept pace with the march of civilization; it has left unsolved some of the age-old problems.

JUVENILE DELINQUENCY

Juvenile delinquency continues to be a major social blemish. It is frequently linked with varying degrees of defect in intelligence, and is alleged by some observers to be mainly an effect of low intelligence. The complexity of the problem is made clear in a report by Maller[1] who studied the records of the children's courts of New York City over a thirty-three-year interval. During that time, 415,000 children were brought before the court, and of these 240,000 were classified as delinquents. Out of the total, 94.4 per cent were boys and 5.6 per cent, girls — a further illustration of the weakness of designating a low IQ as a direct cause. Classifying the cases by decades, Maller shows that, over the three decades, there has been an increase of 40 per cent in delinquency among girls, and a decrease of 42 per cent among boys. Also the rate of delinquency per 1,000 children declined in the first decade from 12.5 to 6.1. The extent of juvenile delinquency was correlated with the educational and psychological status of a neighborhood, high delinquency being found among pupils who were retarded in school, low in intelligence tests, and poor in attendance. As Maller says: "This does not indicate that all delinquents are necessarily dull or retarded but that they come from neighborhoods in which dullness and retardation prevail."

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[1] Maller, J. B.: Juvenile Delinquency in New York City: A Summary of a Comprehensive Report. *Journal of Psychology*, 1937, 3, 1–25.

Maller's general conclusions are consistent with what Shaw[1] has reported for Chicago:

> The present investigation revealed two fundamental aspects of delinquency: that it is concentrated in certain underprivileged neighborhoods and that the rate of delinquency is correlated with economic, social and cultural factors. Any thoroughgoing attempt at the prevention of delinquency must be based on a social program aiming at the improvement of conditions in the neighborhood, the school, and the home. Delinquency is an unmistakable symptom of social maladjustment, and can be removed only by the elimination of the causes of such maladjustment.
>
> The characteristics of delinquency areas are congestion, poor housing and lack of recreational facilities (playgrounds, athletic fields, swimming pools, etc.).
>
> The schools in those areas are overcrowded with no provision for individual attention and guidance. The school could help by reducing the size of class, increasing the number of visiting teachers, adjusting the curriculum to the interests and abilities of its pupils and by providing for a maximum use of the school buildings.
>
> In brief, there is no short cut to crime prevention. Improvement of living conditions, strengthening of the morale in the home, and adjusting the school to the needs of the community would reduce the incidence of personal and social maladjustment which are the fundamental causes of delinquency. (p. 25.)

The Gluecks are not optimistic about the ease with which this particular colossus can be tumbled from its foundations:[2]

> Why should we assume that a large part of delinquency and criminality can be "cured" at all, with the methods at present available? May it not well be that the fiber of criminality is much tougher than we have thus far believed and that its tangled roots lie deeper than we have over-optimistically assumed? Is it not time that the enthusiastic clinical criminologists stopped hunting for a pot of gold at the end of the rainbow they have constructed? Great

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[1] Shaw, Clifford R.: *Delinquency Areas: A Study of the Geographic Distribution of School Truants, Juvenile Delinquents, and Adult Offenders in Chicago.* Chicago, Ill.: University of Chicago Press, 1929. Pp. xxi, 214.

[2] Glueck, Sheldon, and Glueck, Eleanor T.: *One Thousand Juvenile Delinquents: Their Treatment by Court and Clinic.* Cambridge, Mass.: Harvard University Press, 1934. Pp. xxxi, 341.

> humility on the part of all concerned with this colossal problem is called for. We need less exaggerated claims of "success," less optimistic expectations from the various proposals daily made for the reduction or elimination of criminality, fewer newspaper "solutions of the crime problem." And we cannot have too much thoroughgoing research into fundamentals.
>
> In the meantime, no good can come from refusing to face the facts or from any coloring of them. Acknowledgment that thus far the measurable results of clinical and juvenile court effort as exemplified by the Boston situation herein analyzed are highly disappointing — this is the first step that must be firmly taken if the future treatment of juvenile delinquents is to hold forth any promise of real progress. (p. 284.)

All normal young persons are characterized by vigorous physical, emotional, and social drives that can be directed toward ends that are deleterious to youth and intolerable to society. Without full insight on the part of parent, teacher, and clinician there will be allowed to mingle in any population a small percentage of persons who, even as children, display aggressive tendencies, combined with neurotic and psychotic involvements. The diagnosis and treatment of severe forms of these manifestations involve procedures far beyond the facilities available in home, school, or neighborhood. With so much of delinquency and crime fostered in gangs in which leadership may devolve upon unstable persons, the social infection spreads rapidly to children within the normal range of character and behavior. These leaders are dangerous corners which they may fail to get around, for every boy is susceptible to influences that push him away from his standard, middle-of-the-road behavior. Since these crucial happenings occur differentially with respect to social status and parental insight, children in the lower levels are unjustly charged with an inherent desire to break the law.

In the midst of war, Great Britain has reported a distressing increase in juvenile delinquency of all types. The British authorities, in attempting to trace its source, do not mention any lowering of mental status in young persons, for presumably this has not taken place. The facts they stress are these: evacuation of children from homes and familiar neighborhoods; interference with family life during air-raid alarms; parental neglect allied to overwork and fatigue; increased opportunity for crime during blackouts and in devastated areas; attention of police to wartime duties; higher wages available for youth, without experience in budgeting; disruption of schools, clubs, and recreational centers; wartime abandon. The closest generalized term is *child neglect.*

EUGENICS

As we turn to other social problems we find elaborate schemes for improving man's lot by drastic action: a turning away from the slow educative process to the thesis that man cannot improve so long as the wrong people have children — in short, to schemes for getting "nature" to use blueprints in choosing the fittest. All such plans, to work at all, must be conceived on a grand scale. They must be related to valid criteria and to measurements of *genetic fitness.* In the realm of mental ability, we have seen that pitfalls await the unwary worker or reformer. It is not enough to impugn an adult's intelligence; it is necessary to establish that defects existing from birth are genetic in character and indicative of defect in the next generation. Since much has been said about this already, it is desirable now to do nothing more than review the issues involved — to look at some ameliorative plans, practical or not, that have been seriously advanced.

There are no genes for ability or behavior, but there are combinations of genes, the total pattern of which conditions proper physical development. This physical totality, in turn, includes specialized sense organs and nervous structures that set limits to functions and abilities. Conspicuous defects and abnormalities, early detected, lead to diagnoses of characteristic behavior patterns; the atrophied brain in the microcephalic skull has limits that become clear to the clinical psychologist. Other structural, mechanical, or chemical deficiencies may be observed, or postulated, to account for the failure of a brain to develop at a pace considered within the normal range. In all these processes, we have a mixture of factors that are genetic, nutritional, infectious, or behavioral in origin. Analogously, fortunate combinations of factors permit the emergence of strong intellects.

With the high aim of *eugenics* (to be well born) and of *euthenics* (to be well brought up), nobody can quarrel. There are persons willing to devote their energies and loyalties to these principles which, of course, are compatible. There is one group, the eugenists, that emphasizes the social improvement possible through a differential fecundity favoring the "best stock," and another, the educators, charged with bringing to full fruition whatever talent for growth exists within a living generation. In the past, neither group has paid much attention to the findings of the sociologist.

Fascinated by what has been accomplished with plants, bugs, and bulls, some eugenists proclaim the discovery of a master key to the riddle of race improvement — to breed or not to breed, the decision resting less on personal desire than on the legally sanctioned advice of medical experts. Inevitably there has grown up a certain amount of disjunction between the sober writing of geneticists and the expectation of eugenists. Carmichael,[1] with a foot in each camp, observes:

> Society in general, and educators in particular, would do well to promote a really scientific understanding of eugenics or proper parental selection for the children of each generation. If this is done, society may in time learn to avoid some of those breeding procedures that most often perpetuate unsatisfactory brains and inevitably lead to behavior that is defective in those acts called intelligent in any given society. In this connection, it must be recognized, however, that much popular eugenics is not sound when checked against the modern quantitative knowledge amassed by the special biological science of genetics. (p. 144.)

A common assumption is that mild inbreeding, particularly in the lowest social strata, may of itself lead to deterioration. Compared to the meaning of *inbreeding* among domesticated animals, all family lines may be considered highly mixed. In any case a contrary assumption appears valid:[2]

> According to modern genetic principles there is no reason to suppose that inbreeding among good stocks would cause a high frequency of mental deficiency. In so far as inbreeding affects intelligence in isolated regions it would be expected to cause the appearance of greater variation between communities because of some more or less "pure strains" of very superior lines in some localities and of very inferior lines in other localities. It should be noted that the expression "pure strains" is used here in a loose, not

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[1] Carmichael, Leonard: The Physiological Correlates of Intelligence. The Thirty-Ninth Yearbook of the National Society for the Study of Education. *Intelligence: Its Nature and Nurture.* Part I *Comparative and Critical Exposition.* Bloomington, Ill.: Public School Publishing Company, 1940. Pp. xviii, 471. (pp. 93–155.)

[2] Lorimer, Frank, and Osborn, Frederick: *Dynamics of Population.* New York: The Macmillan Company, 1934. Pp. xiii, 461.

> in a strictly technical, sense. There are no "pure" human stocks, in a genetic sense. (p. 207.)

Lorimer and Osborn also discount the efficacy of any eugenic measures that depend upon breeding for the selection of particular strains in family lines.

We may have populations, with different saturations of high physical quality, that are not genetically disparate, the differentials implying only a slight relation to the socioeconomic status of a group. Good talent, like genius itself, is a product of mass improvement: when the mother liquor is strengthened, the statistical chances are enhanced. As Huntington[1] observes:

> Normal and valuable traits, unlike the abnormalities mentioned above (albinism, color-blindness and hemophilia), are usually of compound origin. They are due to the concurrent action of a large number of genes. Hence we can predict the average degree to which they will be present in the offspring of people who possess them, but we cannot tell whether they will be found in the children of any specific mating. From a eugenic standpoint this is all that is necessary. If a trait is inherited at all, its spread can be promoted by the reproduction of the general type of people who possess it. It will become rare if its possessors are prevented from reproducing. (pp. 125–126.)

The best bulwark against deterioration, the one that has never failed, is the improvement of economic and social conditions at all levels. Given decent living standards from top to bottom in this country, it may be that we shall ask most families to raise more children, for a rapid decline in the American population of the twentieth century would please nobody.

The factors cited as *dysgenic* by Lorimer and Osborn[2] may be so regarded without recourse to genetic determinations; it has been disconcerting to all workers to find that a substantial upturn in economic, educational, and social status carries with it the likelihood of biological infertility. However, the negative correlation between the number of children in a family and socioeconomic status may be reversed in sign if the sampling is restricted to a high cultural level. This is shown in a report by Huntington,[3] based on Yale and Harvard graduates.

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[1] Huntington, Ellsworth: *Tomorrow's Children: The Goal of Eugenics.* New York: John Wiley & Sons, Inc., 1935. Pp. x, 139.

[2] *Op. cit.*

[3] Huntington, Ellsworth: A Neglected Tendency in Eugenics. *Social Forces,* 1933, 12, 1–8.

> First, practically all of the most successful men are married — over 95 per cent — whereas only 66 per cent of the least successful tenth are married. Second among those who are married, the percentage who have children is about 84 per cent among the highly successful, but declines steadily to only 60 among the least successful. Again the number of children per father declines in similar fashion from 3.1 among the most successful to 2.2 among the group at the other extreme. The net result is that when the unmarried, the married who have no children, and the fathers are all included, the average number of children per graduate amounts to 2.42 among the most successful and only 0.85 among the least successful. At Harvard the corresponding figures are similar but slightly lower. Moreover, this same contrast between the successful and the unsuccessful is found when the various occupations of the Yale and Harvard graduates are investigated separately. No matter whether we take lawyers, ministers, engineers, bankers, artists, military men, writers, business men, or professors, the successful men, on an average, have decidedly more children than the less successful. Of course there are many notable exceptions, for some of the most competent and valuable people are childless, but we are talking about averages. (pp. 4–5.)

These findings are illustrated in Figure 42. From these and other statistics, Huntington concludes:

> It confirms our other data in suggesting that the diminution in families arising from birth control has run its course among these distinguished men, and that they are returning to a normal situation wherein they will have enough children to replace themselves and to provide for a small increase from generation to generation. Under the impact of the movement for the restriction of families during the last century the ideal family came to be looked upon as having only two children. This ideal is reflected in the size of the families of the men born before 1870. But the pendulum has swung too far. Now it is moving back. That the backward swing should begin among the most distinguished men is natural, for all new movements begin among the more thoughtful and far-sighted members of society. The original movement in the opposite direction toward the reduction of the unduly large families of a century or more ago also began with the leaders. But what the leaders are doing in the present generation, the rank and file will probably do later. (p. 8.)

Forty years ago, G. Stanley Hall[1] served a warning on his fellow-educators:

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[1] Hall, G. Stanley: *Adolescence: Its Psychology and Its Relations to Physiology, Anthropology, Sociology, Sex, Crime, Religion, and Education.* Vol. II. New York: D. Appleton-Century Company, Inc., 1925. Pp. vi, 784.

> . . . it follows either that education is *per se* bad, when considered from a large racial point, or else that a postulate is laid upon us to find, as the right way of education, one which shall not tend to sterility. Otherwise, if higher education became universal, posterity would gradually be eliminated and the race progressively exterminated by schools and teachers. (p. 608.)

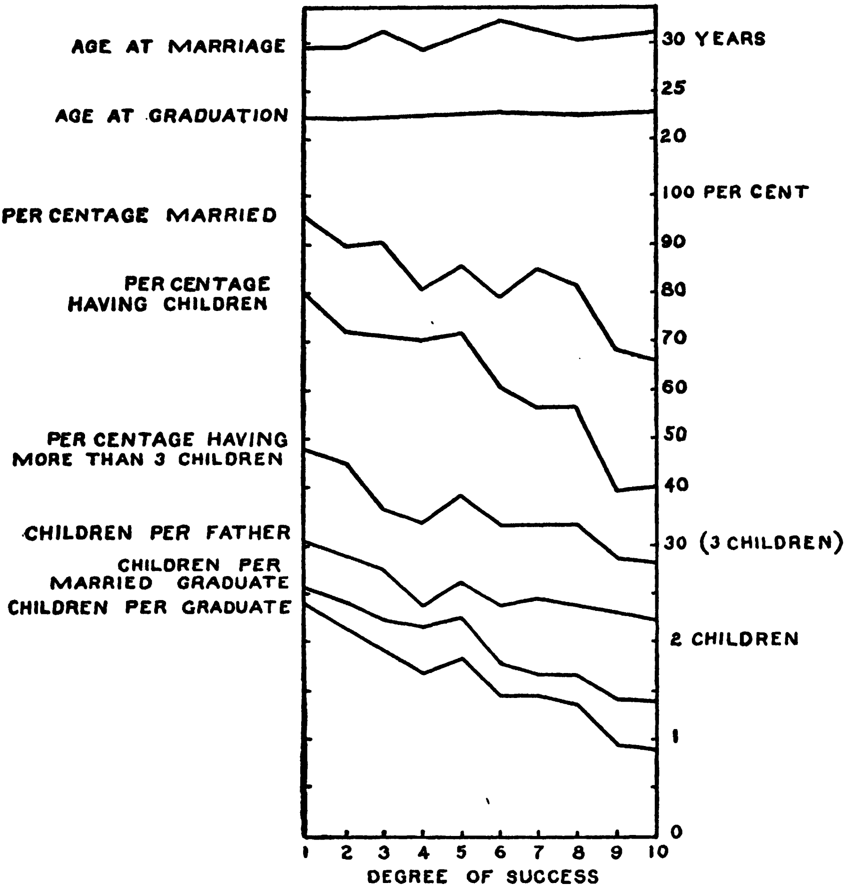

FIG. 42. Family Relationships in Comparison with Degree of Success among Yale Graduates of 1893, 1896, and 1898. (From Huntington, p. 5.)

In this connection, the views of a distinguished physical scientist may be cited:[1]

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[1] Bogert, Marston Taylor: The Chemist as Defender of His Fatherland. *Science*, 1938, 88, 19–21.

> The future of a country and its defense depend not alone upon its birthrate, but also upon the kind of stock it is breeding. It should be a matter of grave concern, therefore, to every nation to make sure that the salaries and living conditions of its intellectuals — its professors and scientific investigators, for example — are not such as to render it difficult or impossible for them to afford the luxury of having children. The real test of a successful life is not how large an estate is amassed, nor how many decorations and other distinctions are won, but how many useful children and grandchildren are left behind you, and how much you did during your lifetime to help protect, teach and train the children of others. It is the human problem which is paramount. The most important crop still remains men and women. We have been so absorbed in making more and better automobiles, airplanes and the host of things which minister to our prosperity or pleasure that we have overlooked completely the far greater need for more and better humans. Things and knowledge are much less important than the nature of the individuals who are to use them, and it is far less difficult to protect ourselves against things than against thoughts. (p. 21.)

Population Trends

The phenomenon of deceleration in the growth of the American population, with indications that the curve may flatten out late in this century, has called forth many a prediction from the social scientists. Some of these are listed by Israeli:[1]

> . . . a decline in population will mean a decline in absolute numbers of those in different intelligence levels and in different occupations. On the one hand, it means fewer idiots and on the other, fewer geniuses. It means fewer laborers and fewer engineers. Considering the probable diminution in the frequency and availability of individuals of high IQ, nations facing a decline in population, a depopulation trend, would without much doubt redouble efforts toward careful development of proper scholastic and occupational programs for gifted individuals. Overabundance of talent may have meant wastage of superior talents in the past; a talent that is about to become rare can not be wasted; educational and occupational avenues for harnessing to the full abilities and talents will be overhauled and transformed to operate for successful training of the superior. (pp. 660–661.)

We may question the easy optimism contained in the statement: "A talent that is about to become rare cannot be wasted." If children, being regarded as valuable, are biologically suppressed on a large scale, by what means will a self-indulgent population do well by the few children that are born? I should predict that a decline in the average number of children per family will be accompanied by a decline in the interest, effort, and expenditure available for the smaller child population. Populations, like nations, deteriorate all over; if dead at the green and growing margins that constitute succeeding generations, they cannot be judged true and sound at the core. As observers coolly map out what the American people must do to care for the aged, it is hard to avoid nostalgia for the pioneering, forward-looking America that dreamt less of comforts than of new worlds to conquer:

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[1] Israeli, Nathan: Psychological Effects of a Decline in Our Future Population. *School and Society*, 1940, 52, 660–662.

> With an aging population would be expected a change in the tenor and tempo of the life of a community or nation. This would mean, for example, that an impetuous and experimental outlook would tend to give way to maturity in the formulation and execution of basic policies. . . . Older people would be at the helm and their activities would reflect maturity and knowledge on the one hand and impatience with novelty and experimentation on the other. . . . Experienced guidance would be overbalanced by red tape and inflexibility. . . . An eclipse of the popularity of pictures produced mainly on the comprehension level of children and an increase in the production of pictures of adult interest and content. . . . Decline in general intelligence, in physical and mental energies, in emotional maturity, in emotional discrimination, in strength of memory for recent events, in orientation upon personal and impersonal situations. (Israeli, p. 661.)

Everybody knows that the American population is growing old; birth control, improved conditions of health, and effective industrial safeguards have all worked in this direction. Of course birth control is a factor only on the assumption that without it parents would have more children than they desire. It does not follow that older generations had larger families entirely because they lacked satisfactory methods of birth control. On the frontier or farm, as in the factory, children were regarded as an economic asset. They created wealth, for willing hands were scarce. Now that the machine, in times of peace, can produce a plethora of consumer's goods, there is sufficient wealth in this country to provide adequately for large families. Yet we are faced with the paradoxical fact of shrinkage. Obviously, the parent of today cannot realize his share of machine-created wealth in the way that was given to the farmer and the farmer's wife who could gaze upon the growing strength and usefulness of their offspring. The breakdown is psychological and social, but it has its roots in our long failure properly to distribute wealth.

Some complications in the whole problem are sketched by Jaffe.[1] He cites the common prediction of statisticians that the American population will reach a peak of about 153,000,000 in 1980 and thereafter decrease. This estimate is based upon present fertility rates and may, of course, be revised upward or downward. For both white and nonwhite populations the only source of growth is in the rural areas. But a precise knowledge of the various factors involved is lacking; we do not know, for example, the relative weights of a high educational level and a high economic status in the furtherance of sterility. Educators may yet be embarrassed by Stanley Hall's frankness.

By a curious inversion of logic, the medical profession, proud of its record in saving lives at all stages from conception upward, has thus far taken no interest whatever in its production. This limited assumption of responsibility applies to every social agency and to the family itself. As society becomes more enlightened, it insists upon group protections for childhood, although it may strive, in a democracy, to retain for each person and each family a maximum responsibility. Where this responsibility is not or cannot be met, as in protective measures against smallpox, diphtheria, venereal disease, or malnutrition, governmental agencies retain the right to impose upon each family measures designed to safeguard the child and the community. Analogously, medical ethics will not sanction abortion as a belated substitute for continence or birth control. Thus we have one of the paradoxes in modern society: for the course of life after birth, the most minute controls, if need be, over physique, mentality, and behavior; for the production of life, complete laissez faire.

Economists who predict deterioration if persons take in each other's washing should now join forces with the psychologist and sociologist to trace out the losses and gains in a declining population. With machines doing the drudgery, transforming materials and sources of power not previously understood, there is an opportunity for two pole-separated outcomes: either an enriched life, forever oriented toward the new and the young, or a fatty degeneration that carries comfort, conservatism, and reminiscence to unworthy extremes.

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[1] Jaffe, A. J.: Population Growth and Fertility Trends in the United States. *Eugenical News*, 1941, 26, 64–68.

After a time America may again encourage immigration — a kind of blood transfusion that, when successful, revives the patient and prepares him for a more vigorous life. Here again the social scientist is faced with an inconsistency. It is the upper economic strata of families with few children that can be expected to demand the exclusion of aliens. They still cherish the old fallacies of a lump of labor and a lump of wealth. While these fallacies contain a kernel of truth under restricted and highly competitive conditions, they should never be resorted to in a steadily aging population whose final security will rest squarely upon the productive capacity of the young, the fit, and the willing.

In the failure of large and privileged sectors of the population to have children, we have discovered the fastest and surest way in which the Western world may spin to its predicted twilight. Within the borders of a nation, eventually the most prolific will rule. In the world as a whole the most fertile tribes, nationalities, and races will prevail, provided only that fertility does not carry with it a reduced efficiency. Families that average two live births or less are on the way to extinction, regardless of their comparative worth in a population.

Culture patterns may serve to stop something that has endured an eon, namely, the life line of a particular column of individuals. A man who is neither parental nor avuncular is the last of a biological sequence that has never been previously interrupted. So far as "natural selection" is concerned, this has no more relevance than the snuffing out of millions of little fishes. Survival phenomena are in terms of percentages; in any species extant the total reproductive urge, by definition, has been strong.

In man, intelligence has become a survival factor; it is his way of using the environment for the welfare of the species. In this sense intelligence, if interfered with or allowed to deteriorate through abnormalities, becomes a weak link in the chain. Man's history is long in its muscular days and short in the period of intellectual predominance. The population that could support itself today on the animal intelligence demonstrated by neolithic man would be small indeed. So strong is the culture pattern, so pointed in the direction of "progress," that complete failure would not take the direction of a return to the primitive. If men die out, the thinning ranks of the survivors will be found not in primeval caves but in spick-and-span sanitariums.

The Meaning of Genetic Determination

That the process of gene-control over physical manifestations is extremely complicated, and at all points linked with environmental variables, has been well documented. Morgan[1] was clear on this a quarter of a century ago. Noting that, in *Drosophila*, fifty different factors affected eye color and fifteen body color, he inferred that a large number of genes was involved in the development of each organ, and further that the whole germ plasm was "instrumental in producing each and every part of the body." Paradoxically,

> *The essential point here is that even although each of the organs of the body may be largely a product of the entire germ-plasm, yet this germ-plasm is made up of units that are independent of each other in at least two respects, viz., in that each one may change (mutate) without the others changing, and in segregation and in crossing over each pair is separable from the others.* (pp. 240–241.)

A decade later, Jennings,[2] who is completely sympathetic to programs for improving the human race, tried to clear up some of the muddied waters:

> Under certain conditions, therefore, a given set of genes may produce a defective individual; under other conditions, a normal one. The defectiveness of the individuals could therefore be prevented either by starting them with a different set of genes, or by changing the environment in which they develop. In the fruit-fly, defectiveness of a certain gene produces under ordinary conditions an abnormal structure of the abdomen. But if the individuals are kept in a dry atmosphere, the abnormality does not appear. A change of environment has prevented the effects of a defective gene. . . . [In man] essentially the same in general principle is the effect of education, training and the like, in changing the behavior

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[1] Morgan, Thomas Hunt: *The Physical Basis of Heredity*. Philadelphia, Pa.: J. B. Lippincott Company, 1919. Pp. 305.

[2] Jennings, H. S.: *The Biological Basis of Human Nature*. New York: W. W Norton & Company, Inc., 1930. Pp. xviii, 384.

> that would without it result from the genes present in the individual. In some of these matters the effects of genes and environment are inextricably intermingled. Behavior is bound to be relative to environment, it cannot be dealt with as dependent on genes alone. A given set of genes may result under one environment in criminality; under another in the career of a useful citizen. (p. 229.)

Jennings estimated that eighty-eight generations would be required to reduce a hypothetical incidence of feeble-mindedness of one per thousand to one per ten thousand! Even this epoch-long program may be optimistic, for his data bear only on cases of feeble-mindedness that are gene-conditioned. Dullness and feeble-mindedness culturally induced (a lowering of the intelligence ratings in large populations) would remain. In fact, without any *gene* modification, at least in the early stages of deterioration, there could be developed whole generations as badly off as the congenitally feeble-minded: in a sick world the feeble, the abnormal, and the degenerate tend to converge.

Waddington[1] advocates a strict caution in eugenical programs:

> In the discussion, in a previous section, of the I.Q. of different classes, it became clear that the environment plays an important part in determining the differences which are found. No sensible eugenical proposals can neglect this important fact. It is clear, for instance, that it would theoretically have been possible to reduce the incidence of small-pox from that characteristic of mediaeval Europe by breeding a resistant stock; but suitable hygienic measures such as vaccination are much easier to apply and much more efficient. Similarly, it is very probable that a much greater improvement in intelligence could be produced by measures of social amelioration than by any eugenical steps which are within the bounds of probability. When it is remembered that we are still uncertain whether hereditary differences have any part at all in causing the class differences in intelligence, while it cannot be denied that the environment has some hand in this, the priority of environmental over genetical methods of raising the general intelligence becomes obvious. (pp. 357-358.)

Little,[2] in 1941, was similarly impressed with the complexity of the problem:

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[1] Waddington, C. H.: *An Introduction to Modern Genetics.* New York: The Macmillan Company, 1939. Pp. 441.

[2] Little, K. L.: The Study of Racial Mixture in the British Commonwealth. *Eugenics Review,* 1941, 32, 114-120.

> Complicated as is the environmental machinery which impinges upon the ordinary rat, the factors which affect Man are a hundred times more inextricable and diverse in character, and as is equally plain, many times more so than in the case of (say) Drosophila. Such work on genetical lines that has been done on animals closest to humans, as, for instance, the ape, more than supports the argument of complexity. Surely, then, it is to be looked upon rather as a logical consequence of the nature of man's biological equipment than as a cause for wonderment and even disappointment that the mechanism of human heredity has not yielded all its secrets to lines of inquiry compatible with the wielding of the microscope. Indeed, what conclusions have so far been reached point quite the other way: that far from following out any simple process, human heredity unfolds itself in many directly unanalysable ways. Certain traits and characters follow automatically from certain miscegenations: others appear to require definite though often unspecifiable environmental conditions to evoke them. Some features rise clearly above all external inhibitions; others, if latent, are obscured by social, climatic and nutritional influences. (p. 119.)

As I have said elsewhere:[1]

> The general theory is clear. In the limiting case of congenital low-grade idiocy, environment has very little chance to mobilize its forces. In this case there is hope only if the idiocy is some direct resultant from endocrinal deficiency, a deficiency that might be counteracted. In other types of idiocy, growth potentials will have been well-nigh extinguished.
>
> As we move up the scale the possibilities change somewhat. There is no evidence that the growing child, regardless of environmental impacts, will reach a mental status already determined in the genes. We do not know how much of intelligence is really determined in human genes. But even if we had pure-bred stocks over many generations, we should still be unable to answer the question as to how closely, through breeding alone, a child could approach its maximal mental rating. The environment will operate whenever it gets a chance to operate.
>
> We can conceive of a limiting case that is the counterpart of congenital idiocy; namely, that of a child deprived of all opportunities for stimulation, experience, or education. That persistence of the environmental impoverishment will stabilize the inferiority, no one can deny. But a measure of the *permanent* damage done to

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[1] Stoddard, George D.: Introducing the Yearbook on *Intelligence: Its Nature and Nurture.* Addresses and discussions presenting the Thirty-Ninth Yearbook of the National Society for the Study of Education in Joint Sessions with the American Educational Research Association and the National Society of College Teachers of Education. Salem, Mass.: Newcomb and Gauss, 1940. Pp. 84. (pp. 3–9.)

> nervous tissue, such that complete recovery is counter-indicated when conditions are radically improved, has not thus far been obtainable. The need for physiological and neurological data is evident, together with correlated materials on learning, motivation, and habit formation. (pp. 7–8.)

Some eugenists hold that feeble-mindedness may be due to only a few genes, and on this assumption make further predictions of social ameliorations through genetic control. To quote Burlingame:[1]

> Unfortunately the actual number of gene pairs involved is not known but must be several. For this reason an exact rate cannot be calculated, but is quite certain to be large in any event. The present situation is one in which it seems probable that no reproduction of all parents below I.Q. 90 would practically wipe out feeble-mindedness in a single generation. Practically that is unimportant, since no one would propose so drastic a change in the population in such a short interval as a single generation. Its social and economic effects would probably dwarf those of any possible revolution or war that can readily be imagined. (p. 278.)

Were we to extend Burlingame's estimates to the stamping out, not only of feeble-mindedness, but of other social problems such as divorce, delinquency, crime, and psychopathy, we should be moving toward a program of racial extinction not vastly different from Charles Lamb's "modest proposal"!

It is refreshing to compare the wild surmise of the enthusiastic eugenist with the actual accomplishments of Skeels and his associates, as reviewed in this volume. It is, of course, absurd to think about the mutilation of ten million citizens in order to "improve" the nation. There is a lot of common sense among common people; they know that a country could not endure that much ruin. Moreover they can be reassured — a drastic program of sterilization would not eliminate the unfit, nor would it protect those children, allegedly of "poor stock," who turn out well. This view was supported by the British Board of Education and Board of Control:[2]

> Sterilisation, segregation and even the more moderate remedial measure of the regulation of marriage, if they are to prove completely

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[1] Burlingame, L. L.: *Heredity and Social Problems.* New York: McGraw-Hill Book Company, Inc., 1940. Pp. xi, 369.

[2] British Board of Education and Board of Control: *Report of the Mental Deficiency Committee.* London: H. M. Stationery Office, 1929. Pp. xi, 239.

> effective as *preventive* measures, must be applied to the whole subnormal group, that is to approximately ten per cent of the whole population. This obviously is impracticable. . . .
>
> [The Committee members] feel however that there is not sufficient evidence at present to justify the general adoption of sterilisation of defectives and are convinced that even if it were adopted no great alleviation of the burden of mental deficiency would follow. (pp. 82, 88.)

In this country, the able, wealthy, conscientious persons who join eugenical associations may be startled by the tongue-in-cheek remarks of Haldane:[1]

> My own views on the differential birth-rate are extremely tentative, but they are somewhat as follows: If the rich are infertile because they are rich, they might become less so if they were made less rich. A uniform and free school system, although it might be bad from the educational point of view, would probably be good from a eugenic point of view, as parents would not restrict their families to give their children a good education. I am inclined to believe inheritance of wealth eugenically undesirable, because it tends to make the well-to-do limit their families.
>
> Curiously enough, the inheritance of property has been defended on genetical grounds. It has been claimed that a man who makes a fortune is abler than the average, and that it is desirable that property should be in the hands of able men and women, who will utilize it to the best advantage. Further, the children of able men are abler than the average, and should therefore inherit the property. Let us, for the moment, accept the validity of this argument, and examine its consequences quantitatively. The correlation between parents and offspring as regards intellectual attainments is about half. This is partly due to direct heredity, partly to indirect heredity determined by the fact that the spouses of intelligent people are, on the whole, rather more intelligent than the average, and partly to environmental influences.
>
> A correlation of half means that given the parent's intelligence grade, the variance (mean square of deviations from the mean) of the offspring is reduced to three-quarters of its value in the general population. In other words, one-quarter of the causes making for variation have been removed. On this basis it would seem fair that one-quarter of the property should be handed down, i.e., that death duties should average 75 per cent. I do not put forward this argument very seriously. But it seems to me about as good as the opposing argument. (pp. 134–135.)

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[1] Haldane, J. B. S.: *Heredity and Politics*. New York: W. W. Norton & Company, Inc., 1938. Pp. 202.

The Popular Literature

Thus far most of the eugenic literature has been produced by proponents of the movement. All the documents I have examined appear to be the work of sincere persons, but they are in no sense

TABLE 30

REPORT ON STERILIZATIONS UP TO JANUARY 1, 1939

State	*Year First Adopted*	*Sterilizations Performed*		*Total*
		Male	*Female*	
Alabama	1919	129	95	224
Arizona	1929	10	10	20
California	1909	6,665	6,276	12,941
Connecticut	1909	23	381	404
Delaware	1923	298	261	559
Georgia	1937	0	0	0
Idaho	1925	4	10	14
Indiana	1907	445	351	796
Iowa	1911	79	110	189
Kansas	1913	1,230	818	2,048
Maine	1925	14	131	145
Michigan	1913	464	1,477	1,941
Minnesota	1925	313	1,310	1,623
Mississippi	1928	127	318	445
Montana	1923	40	97	137
Nebraska	1915	139	211	350
New Hampshire	1917	63	315	378
New York *	1912	1	41	42
North Carolina	1919	142	578	720
North Dakota	1913	137	307	444
Oklahoma	1931	79	293	372
Oregon	1917	484	823	1,307
South Carolina	1935	0	11	11
South Dakota	1917	159	294	453
Utah	1925	86	98	184
Vermont	1931	51	128	179
Virginia	1924	1,348	1,910	3,258
Washington	1909	116	344	460
West Virginia	1929	1	30	31
Wisconsin	1913	148	867	1,015
Total		12,795	17,895	30,690

1. Voluntary sterilizations in state penitentiaries of California not included above 391
2. The above figures were furnished by state authorities.
3. In many states lacking sterilization laws, the state institutions sterilize patients with consent. No account is here taken of such operations, nor of those that are primarily therapeutic, not eugenic, in purpose.

* The New York law was declared unconstitutional in 1918.

the reports of research projects. The movement has gone ahead almost entirely in terms of the persuasiveness of its sponsors and the desirability of its goals. Its success (in terms of operations) has varied from state to state. Table 30 is taken from "Human Sterilization Today," a pamphlet recently published by the Human Betterment Foundation of Pasadena, California.

In the same pamphlet, the difference in efficacy between sterilization and contraception is vividly portrayed:

> Eugenic sterilization, primarily, is applied by the state or with its sanction, to persons who would be likely to produce defective children. It protects such persons, their potential children, the state, and posterity. Such persons do not have the intelligence, the foresight, or the self-control, to handle contraceptives successfully, nor the ability to care for children intelligently. Sterilization is practically irreversible — permanent — and 100% effective. It is the only method of birth control which defectives can use successfully.
>
> Birth control by contraceptive methods is voluntary and applied by the individual for his own purposes. It requires extreme care, intelligence, and a practical biological understanding of the problem. When not applied under definite instructions from a competent experienced physician or nurse, after examination, it frequently results in failure. At best, what succeeds with one may fail with another, especially with the young and inexperienced. (pp. 7–8.)

Further Dilemmas

It is hard to escape from a dilemma: birth control is effective only among persons who, according to the eugenist, should have large numbers of children. A test of the seriousness of approach to the whole question of eugenics will lie in the ability of any group or state to match its sterilization program with equally effective provisions for the bearing of children. For the socially inferior, contraceptive methods permit some childbearing; for the socially elite, they permit birth extinction and the termination of family lines.

The problem of the informed eugenist is well expressed by Osborn.[1] He believes that "eugenics and democracy are significantly interrelated"; in a good society the best people will voluntarily have the most children. According to Osborn, the individual citizen need relinquish the power of eminent domain only "in the case of extreme defect." But such persons are the idiots and low-grade imbeciles who may appear in average or above-average families — for them, completely adequate birth control is attained by institutionalization. As we go above these levels, medical authorities must ask questions of the feeble-minded and the insane (for this is a condition of "voluntary" surgery) to which persons so classified cannot be expected to give a competent answer. The greater dilemma lies in the ethical schism by which a state is empowered to demand of any citizen the relinquishment of an age-old right, the right to have children — in juxtaposition with a conspicuous reluctance to demand the procreation of children by citizens who rank among the best in physique, intellect, and behavior.

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[1] Osborn, Frederick: *Preface to Eugenics*. New York: Harper & Brothers, 1940. Pp. xi, 312.

In wartime there is work to do. Work that is considered crucial can be done by large numbers of men who rank low in the mental and social scale. A glance at the personnel records of men accepted for military and naval service, whether in 1918 or 1942, will furnish ample evidence. Even in a world of machines, there is a tremendous need for manpower, for the machine-tender is an essential part of an industrialized democracy. Manpower, too, in its special devotion to personal services of every description, as in defense, health, education, and the arts, is the keystone of peace and progress. The children of machine-tenders, of all those who serve, given good economic and educational opportunities, will become a great reservoir of economic power, mental talent, and artistic creativity. In a democracy, it is only one generation from callous to cortex.

In this connection Tredgold[1] has a few words to say:

> It is sometimes asserted that these various forms of social inefficiency are produced by morally and physically unhealthy surroundings and slum life. But the facts are against this view. Vital statistics show that the conditions are more favourable to health and longevity in the rural than they are in the urban and industrial districts; and yet in the rural districts the incidence of mental defect is over 50 per cent. higher than it is in the towns and industrial areas. I have explained in a previous chapter that this is in all probability largely due to the steady migration of many of the more efficient

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[1] Tredgold, A. F.: *A Text-Book of Mental Deficiency.* Baltimore, Md.: William Wood & Company, 1937. Pp. xvi, 556.

> and enterprising country dwellers to the towns, and of the intermarrying of those left behind. There is possibly also another factor which may here be mentioned. The infantile mortality rate is less in the country than it is in the towns; the towns also differ among themselves in this respect. In general, it has been found that a low infantile mortality rate, whether due to naturally healthy conditions as in the country or to life-saving measures as in some of the towns, is associated with a higher incidence of mental defect than is a high mortality rate. In other words, the incidence of mental defect tends to vary indirectly with the infantile mortality rate, and a high rate weeds out a greater proportion of the unfit. No doubt a low infantile death-rate results in the preservation of many useful lives; but it preserves the liabilities as well as the assets of the race, and it appears to be preserving more liabilities than assets. (p. 521.)

Tredgold's thesis seems to be, let the children die in order that the race may live. We wonder what he would expect to find in an American county of *highest* infantile mortality, as in some underprivileged Negro community in the deep south — presumably such a dissolving out of physical and mental defects as to make the region a true cradle of life, liberty, and the pursuit of happiness!

Pointing out that sterilization of the insane is not a mass procedure, Popenoe and Gosney state what some would have predicted:[1]

> There is little to justify the fear that sterilization may prevent the birth of the nation's future leaders. . . . Our two studies of the sterilized insane in California showed, in fact, that the largest group came from the ranks of unskilled labor and, even below this, from the ranks of vagrants, dependents, and unemployables. (p. 10.)

The largest number of patients sterilized were suffering from dementia praecox or manic depressive psychoses. The authors hold that these afflictions are hereditary. It must be remembered that Darwin regarded tuberculosis as a truly hereditary disease; it was easy to buttress such a statement with convincing statistics. In medical practice it is axiomatic that the designation *inherited* is likely to be applied when the organic factors in a disease are obscure. Should sulphanilamide, or some other wonder-working drug, clear up certain types of insanity, we should be left again with a great social fallacy. The authors point out that the feeble-minded are also available for sterilization and that the "dividing line of 70 IQ is often taken arbitrarily for convenience to make the line between 'normal' mentality and mental deficiency." (Is it fair to ask, *whose convenience?*) They proceed:

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[1] Popenoe, Paul, and Gosney, E. S.: *Twenty-eight Years of Sterilization in California.* Pasadena, Calif.: Human Betterment Foundation, 1939. Pp. 47.

> Characterized by lack of foresight, self-control, and judgment, by ignorance, indifference, and frequently alcoholism, mentally defective persons do not limit their families as do the college and high school graduates. Hence investigations in many states agree with our researches in California which showed that educated families are dying out, while the families of the feeble-minded and of the chronic paupers are not only holding their own, but are increasing. (p. 22.)

Perhaps it is well that the defectives do not act like the graduates of the typical woman's college who delight statisticians by averaging ½ or ⅔ of a child per family. A slight revision of Popenoe and Gosney's sentence produces this one: Characterized by lack of foresight and judgment, by ignorance, indifference, and frequently alcoholism, college graduates do not create families — they leave that onerous task to their inferiors.

Positive Eugenic Programs

As we turn from the California program, which fortunately has not set the pattern for the whole country, to carefully considered programs (in which sterilization has a limited medical appropriateness), a geneticist may furnish the guiding principle:[1]

> If there were a central directing agency which had the power as well as the wisdom to control matings within the group, something could undoubtedly be done slowly to elevate the general average of bodily vigor or innate mental power within the group. This could be done most rapidly by polygamy which would permit of a relatively rigid selection of sires; less rapidly under monogamy by a selection of parents among both sexes, the offspring to be cared for largely by the rest of the community. But the social consequences of either of these methods are so tremendous, so subversive are they of individual liberty, that no modern civilized community has been willing to contemplate either of them. The whole movement of modern times is in an opposite direction. Practically, therefore, we are limited to such eugenic measures as the individual will voluntarily take in the light of present knowledge of heredity. (p. 374.)

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[1] Castle, W. E.: *Genetics and Eugenics.* Cambridge, Mass.: Harvard University Press, 1927. Pp. viii, 434.

Below is given the "positive eugenics program" presented at a Conference on Eugenics in Relation to Nursing.[1] (The whole program is really a mixture of eugenics and euthenics, with the more practical suggestions in behalf of the latter.)

1. A carefully planned effort to implant in the minds of the able, healthy young Americans — through churches, magazines, newspapers, radio, etc. — that children, several in each family, are highly desirable. It seems imperative that high schools and colleges be prepared to incorporate into their plan of education, effective preparation for home-making and parenthood.
2. Improved housing, so that home-making may be possible.
3. If needed, economic aid to the able young people who should have children, in the form of marriage loans, maternity benefits, etc.
4. Safeguarding of home and income through some type of provision for periods of sickness and unemployment.
5. The promotion of pre-marriage consultation service, with complete health examinations of man and woman.
6. Marriage consultation, combined with maternity service of acceptable quality and at such cost as the self-respecting family can afford.
7. Undergraduate and graduate courses, including scientific eugenic facts with their sociological and health implications for all those who work in the field of family health service. Perhaps the eugenics experts might study the courses available and suggest more practical and effective content and method.
8. Education and legislation which will permit and require sterilization of those who can not produce desirable offspring. (p. 19.)

In a subsequent Conference on Eugenics in Relation to Education, Frank[2] comes to the support of nursery schools and parent education as a sound eugenic measure.

We may look forward, then, to a growing recognition in organized education of a legitimate need for nursery schools that will provide really competent supervision, mental, physical, nutritional, social,

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[1] Dines, Alta E.: Report on the Conference on Eugenics in Relation to Nursing [New York City, February 24, 1937]. *American Eugenics Society Report of the Conferences on the Relation of Eugenics to the Fields of Recreation, Nursing, Education and Medicine*, May 14, 1937. Pp. 38. (pp. 16–19.)

[2] Frank, Lawrence K.: Report of Conference on Eugenics in Education [New York City, March 20, 1937]. *American Eugenics Society Report of the Conferences on the Relation of Eugenics to the Fields of Recreation, Nursing, Education and Medicine*, May 14, 1937. Pp. 38. (pp. 23–28.)

> of the young child's development; parent education and child study meetings to keep the parents informed of the newer developments in child rearing, and to communicate the newer insights and understandings about wholesome personality development and the protection of the child's mental health; school medical services, physical education and hygiene, psychiatric services and the wide variety of instruction and wise supervision of activities, athletic, artistic, recreational, etc., so necessary to rounded, wholesome development and social adjustment of children; and, more generally, the adoption of the conception of the school as essentially *the* child welfare agency of society. (pp. 24–25.)

A group of twenty-three English scientific workers (including Haldane, Hogben, Huxley, and Waddington) recently have attempted to answer the question, How could the world's population be improved most effectively genetically? They offer no easy pathway along strictly genetic lines. After pointing out that the first prerequisite of *genetic* improvement is a social setting which will afford equal opportunities to all members of society, they unite in support of certain principles:

(1) The elimination of antagonisms between different peoples, nations, and races.

(2) Economic, medical, and educational aids in the rearing of children; production for the benefit of worker and consumer.

(3) Birth control, both negative and positive.

(4) "Recognition of the truth that both environment and heredity constitute dominating and inescapable complementary factors in human wellbeing."

(5) Selection along lines that are social, as in health, intelligence, and fellow-feeling.

All this, they believe, can be accomplished only if scientists pool their resources in behalf of complex research programs:[1]

> The effectiveness of such progress, however, would demand increasingly extensive and intensive research in human genetics and in the numerous fields correlated therewith. This would involve the co-operation of specialists in various branches of medicine, psychology, chemistry and not least the social sciences, with the improvement of the inner constitution of man himself as their central theme. The organization of the human body is marvellously

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[1] Crew, F. A. E., Darlington, C. D., Haldane, J. B. S., *et al.*: Social Biology and Population Improvement. *Nature*, London, 1939, 144, 521–522.

> intricate, and the study of its genetics is beset with special difficulties which require the prosecution of research in this field to be on a much vaster scale, as well as more exact and analytical, than hitherto contemplated. This can, however, come about when men's minds are turned from war and hate and the struggle for the elementary means of subsistence to larger aims, pursued in common. (p. 522.)

How different concepts of eugenics may alter social administration, is illustrated in the recommendations on the adoption of children in two states. In Massachusetts:

> It is also desirable to investigate thoroughly the hereditary and social background of the child. Special attention should be given to the search for evidence of mental disease, intellectual inadequacy, severe emotional instability, general economic incompetency and shiftlessness, pronounced alcoholism, epilepsy, diabetes, syphilis, hemophilia, exposure to tuberculosis and congenital abnormalities present in other members of the family but recessive in the child. (p. 15.)[1]

In Iowa:

> Our placement policy, then, is based on the belief that any child who is born without physical defects or abnormalities has every possibility of developing normally, provided he is given adequate physical care, sufficient mental stimulation, and the emotional security that comes from feeling that he belongs and matters to some one.
>
> Barring physical and organic defects a child in an adequate home and community will develop at least normal intelligence. The same child, placed in an inferior home and given few outside experiences, will probably not reach as high a level as he would under the more favorable circumstances. . . .
>
> However, we have no intention of discounting the importance of heredity or of suggesting that all children are born with equal potentialities for growth, either mental or physical. We do believe that all children who are medically and physically normal have a sound heredity which will permit development within the normal range. We feel that this is true for either own or foster children, whether the parents are of so-called high or low social levels.
>
> Defective children are not placed in foster homes, no matter how excellent the social history may appear to be. For this reason it is safe to say that people adopting a child take no greater chances than those having their own children. In many ways they take less

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[1] Spencer, Harvey: Adoption of Children. *Bulletin of the Massachusetts Department of Mental Diseases,* 1935, 19, 14–17.

chances, since major defects such as birth injuries, physical abnormalities, and organic defects are ruled out.[1]

While the Massachusetts and Iowa policies outlined above are strongly opposed in principle, we need not conclude that, over the years, the two populations of children will differ from one another. I predict that a follow-up study, based on substantial samplings in these two states (preliminary evidence for the Iowa children has already been cited), will show the foster children to be above average in intelligence, character, and vocational success. Furthermore, the children of these children should assume cultural roles consistent with that of their parents or of their foster grandparents. The main divergence as between Massachusetts and Iowa children will not be found in a comparison of these samples; it will appear in the population of children rejected in Massachusetts (because of poor family history), but accepted in Iowa. These Iowa children should not depart significantly from the rest of the sampling. But illegitimate children in Massachusetts, who by the imputations *of heredity alone* are denied the privilege of foster care, will constitute an inferior crop; for reasons that may not be hereditary, they will seem to validate a hereditarian thesis. A child deprived of milk because his mother dislikes it will develop physical deficiencies that are not gene-carried.

Lorimer and Osborn[2] proposed for Negroes an experiment similar to the Skeels study in Iowa (on white children):

> One study, which, although expensive, would cost much less than has been spent on various inconclusive studies in this field, could be counted on to yield conclusive results regarding the hereditary capacities of the broad Negro masses for intellectual development. A social agency, or several coöperating social agencies, might obtain jurisdiction over an adequate number of orphan children under one year of age derived from representative black parents in Southern rural communities. These babies could then be carried North and placed as adopted children in the homes of well-educated, intelligent urban Negroes, who might be interested in the experiment, but who primarily would be motivated by the considerations that normally lead families to adopt children. The children could then be tested, first in their homes and later in their schools, without

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[1] Iowa Board of Control of State Institutions, The Children's Division: *Adopting a Child*, 1941.

[2] *Op. cit.*

> ever being made conscious of the experiment. After such an experiment, if competently managed, we would really *know* something about the capacities of some ten million American citizens. The results of such a study might be of far reaching importance in determining educational and other social policies affecting Negroes. (p. 228.)

We can predict that the major characteristic of the curve of Negro intelligence would be its *overlap* with the whites, and further that the transplanted population would move upward in response to favorable environmental influences. Whether the two curves would finally approach the same limits in general intelligence and special aptitudes could be decided only in terms of better tests than we now have and of deeper insight into the dynamics of stimulation.

TALENT IN A DEMOCRACY

All biologists agree that evolution gives no assurance of permanent improvement. The human race as a society of reproducing individuals cannot resist change, but the course of events can be downward. If it is true, as some observers believe, that man already has ceased to rely on his intellect, giving himself over to emotional outbursts and reality-dodging substitutes for thinking, then man as a species is truly in a bad way. The emotions aroused *in the most civilized society* are not primarily those of friendliness, love of children, or love of humanity. The strong drives attached to anger, fear, hate, greed, and revenge are highly dangerous: they do not take the place of beautiful emotional experiences and they run counter to the forces of logic and scientific progress.

Modern society offers few equalities of opportunity. The conditions that modify intelligence are as heterogeneous as the sources of its organic components. There are civilizations out of touch and out of tune with ours that have survived through unique economic structures, sustained by alien customs. In certain favored areas, it is true, Euro-American culture has made advances which are evidenced by (*a*) the arrival of a few persons at the highest peaks of intellectual or artistic attainment, (*b*) a widening of the base of intellectual preparedness to a degree hitherto unknown in the world, and (*c*) a remarkable facility in technology, industry, and organization. A price has been paid for all this, for we can discern numerous deprivations and malformations.

For example, there are some forms of ugliness that would have been so designated by an informed group of observers in any era. Bad designs in art and architecture have been spread over the land; linked with hit-and-miss "developments," they have kept many American towns unkempt and unpleasant. Social intelligence is not the same as individual intelligence, but it is inevitably mediated through persons in authority. Only a great people can plan and maintain a great city. Paris today is like a beautiful woman who has fallen in the mud — to lie there until rescued and cleansed by those who believe, endure, and love. On the whole, American cities are improving, and the charm of the well-kept countryside is something a farmer or villager can appreciate openly, with pride and feeling. These expressions of intelligence are as symbolic and creative as anything contained in the language arts.

Whenever man depends too strongly upon a luxury, as in refined food, shelter, transportation, or armament, the luxury becomes a necessity. If anything disturbs man's vast network of technologies, deterioration sets in. So it may be within the organism itself. The cerebral cortex, luxury of luxuries among all the animals, has become essential to man's health, sanity, and survival. Man, a degenerate in hair, teeth, claws, sensory acuity, and fertility, can no longer lead the primitive life of the cave. He will live or die depending upon his last cerebral refinement; if his fancy crutch fails him, he is lost.

It takes no frontal tumor to knock out the brain. The abscesses of fear, magic, and murderousness serve equally well and are more readily distributed to large populations. In fact, for the most deadly and universal mental afflictions, starting from the impact of man upon man, it is necessary to postulate healthy tissues, in order that the phobia may take hold and effectively run its degenerative course. If man is to be driven to destruction by attaching negative signs to good deeds and positive signs to bad, his mechanism should have all its parts in good working order, running smoothly. To get back to the dark ages is to direct mental power toward a desperate flight from science and human justice. All the tumors the world has ever known have not been so destructive of human beings and human aspirations as single-purpose concepts like *witchcraft*, *divine right*, *original sin*, *heresy*, *racial superiority*, and *might makes right.* These hallmarks of weak minds would have been recognized as such had they not served powerful groups that used them to advantage. Embedded in folklore, dogma, or political platform, twisted ideas have been sent forth to plague generations of men whose cerebral lobes had been doing all right.

Since differences among individuals are transcendent over those between national or racial groups, we may pause to ask, Why is there such an ongoing interest in defining, measuring, and labeling racial characteristics? Very likely the doctrine of racial inferiority, as for the Negro in America, constitutes a social need for millions of white persons who cannot otherwise escape the unpleasant outcomes of their own actions and attitudes: it is inacceptable for a not-too-secure majority to regard Negro inferiority as the product of a long history of economic and cultural impoverishment. As for the Negro, so for any minority group that gets off to a slow start in socioeconomic competition, with this difference: the Negro is scarcely responsible for the color that marks his status. That he, too, is not blameless is indicated by the development of caste systems within the race that achieve a measure of acceptance if based on differentials of wealth, profession, or pigmentation.

Sociologists have predicted the gradual amalgamation of all races on the American continents, pointing out that the process is well along in some countries to the south of the United States. There is evidence that the new blends can establish high forms of culture. In this country miscegenation is barred by law in some states; since it would not be regarded with indifference in the other states, we may regard such laws and customs as founded on almost universal agreement. In decisions that stress individual choice, democratic principles do not demand the negation, leading to hypocrisy, of striking differences in appearance or social acceptance. Intermarrying, then, probably takes place chiefly among racial stocks that are already diluted and under conditions of socioeconomic exchange that reduce disparities. This leaves for the exercise of democratic practice all the freedoms involved in the constitutional Bill of Rights, and provides for their implementation in terms of goods, services, protections, and opportunities.

In their zeal to protect a mythically "pure" American stock, well-meaning persons advocate doctrines of racism that have no counterpart in factual data — "races" tend to be identified with nationalities or geographical areas, always in a hierarchy that brings the so-called "Nordic" on top. The disastrous outcome of such discrimination in Nazi Germany should deter any organization that seeks to discover scapegoats within the ingredients of the great American melting pot. The tiniest flame of hatred directed against any loyal group should be the signal for vigorous countermeasures.

Literally hundreds of groups, associated for mutual benefits and satisfactions, exploit their private interrelationships by raising high the barriers against the nonbelievers or the nonaccepted, regarding others (who are indeed friendly fellow citizens) as aliens, inferiors, or barbarians. If every person, from birth upward, were to be regarded fundamentally as a *member of a family*, as a *worker*, and as a *citizen*, some of the divisive factors in our social order would be reduced — we should see the oneness of man in society; we should sense the meaning of home, of labor, government, education, science, art, and religion: we should, in fact, test every social form by its unique contribution to the integrity of the threefold man: the homemaker, the worker, the citizen.

Surviving Myths

A major error of our times is to read about old superstitions as if they were dead and gone. What we need, perhaps, is more exercise in the identification of myth-survival. For example, the advertiser is the modern medicine man. He assumes strange disguises and mutters weird incantations. His images are repeated in three-color plates for the millions to see; his abracadabra rides the radio waves. Frequently what he says is right, and his facts could be verified by scientific test. They need to be so checked, for he is not trying to arrive at scientific truth; his goal is persuasion. The writers of superior advertising copy, and the journals that carry it, prefer to have truth and justice on their side, but there is little insistence. In our present-day culture, under no circumstances is an advertisement to be considered a source of objective evaluation; its inmost nature is inconsistent with such a role.

All this is said not to eliminate advertising, which has a large and useful place in description, illustration, and comparison, but to reveal a social schizophrenia that has been allowed to develop.

Having cultivated man's thinking, having created laboratories and libraries to discover and conserve truth, we then, on the other hand, encourage human beings to use their best efforts to shake man from his logic and his science. We spend more money marketing inferior goods than we do in researches designed to aid the consumer. For example, we aid agriculture through scientific experiment, growing better crops at smaller cost so that they can be widely, if not universally, distributed. Having done this, we "refine" out of food the very elements that science regards as essential. That this is notoriously bad economics, involving an unnecessary drain upon land, transportation, machinery, labor, and marketing, is something for the economist to worry about; that it is another mark of deficiency in social intelligence, can scarcely be denied.

The present enrichment of bread, through the addition of separately manufactured vitamins, is simply a stopgap measure: having broken a leg with painful consequences to the patient, we now provide a good splint. We are told that persons prefer white bread and we discover that there is a measure of truth in this contention. Unfortunately for its complete acceptability, we discover that the taste for white bread is itself synthetic; it is something new in the world, and almost exclusively American — it is a product of millions of dollars' worth of high-pressure advertising that associated whiteness with purity and pleasantness. Would any other animal depend upon the eye alone for testing its fundamental food ration — disregarding smell, taste, texture, and subsequent organic clews in favor of sheer visual, cellophaned imagery? We look at it and say, "This is good to eat"; the more we eat of it (to the neglect of other foods), the faster we deteriorate! Through such means man has learned to ruin himself as has no other species.

THE PLACE OF SCIENCE

Science is supported chiefly because it strengthens man. It is an aid to health and further development. The only social purpose in knowing about calories and vitamins (apart from the curiosities of individual men) is to rise above our primitive forebears. In this example of the treatment of cereals that are still crucial in world economy, society has failed. Since the failure is not in technical knowledge and is certainly not malicious, it should be sought in the usual focus of infection — in education and the social sciences.

If we turn to examples in patent medicines and fake medical procedures, the story is equally dismal, but more familiar. In medieval days there was a mixture of truth and error, of science and superstition. During epidemics a few men sensed what was happening, but the authorities could hardly distinguish the prophet from the quack. (This is brought out in Goldwin Smith's revealing account.[1]) Analogously, a medical history of the twentieth century will cover not only Class A medical schools, but divers theories and practices that cannot tolerate a scientific scrutiny. Whoever, in the year 2000, writes the history of medicine, summing up the century, can find help in a paper read by the present medical director of the Rockefeller Foundation.[2] He deplores the neglect by scientific medicine of its peripheral and underlying regions. Its coolness, for example, toward pharmacology, physical therapy, radiation, and psychology, has long since invited dubious activities by persons aware of the gaps in standard medical practice.

What is there about the human mind that permits dichotomous, mutually inconsistent developments to arise among men in the full possession of their intelligence, and with easy access to the riches of science? Wherein are we defective; what is the growing saber tooth within our skulls? The answers are not easy.

The way to truth is through a sea of untruth. The chart must always be science, that is, science viewed as a method. Its controls will keep our thinking straight even when it goes over from the physical or biological to the social, ethical, and philosophical. This thought-continuum does not represent a progressive abandonment of one logical system for another, but it does permit, above the level of general education, a division of labor. To illustrate, there should be, between the physician and the economist, a shared ground of insight and experience, together with mutual confidence in special endeavors.

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[1] Smith, Goldwin: The Practice of Medicine in Tudor England. *Scientific Monthly*, N. Y., 1940, 50, 65–72.

[2] Gregg, Alan: Addenda to the Agenda for the Decade 1940–1950. *Proceedings of the Annual Congress on Medical Education and Licensure*, Chicago, February 12 and 13, 1940. Pp. 67. (pp. 6–8.)

ECONOMICS, POLITICS, AND FORENSICS

So far as the distribution of wealth is concerned, we can afford to give up the life-death dichotomy; biology need not forever operate against planned economics. The economic man, himself in the ghostly tradition, may be shaded into death, decade by decade. A good start could be made at age fifty. Let economists and actuaries work upon the problem of distribution-during-lifetime for owners at ages fifty, sixty, seventy, eighty, and ninety. (All centenarians should become public heroes, who, in return for a guaranteed security-with-honor, would offer themselves as subjects of elaborate medical and psychological tests.) Annual tables would be a nuisance and a hazard, but decennial regulations would encourage all concerned better to plan their lives.

Now is a good time, too, to abandon the idea that at age twenty-one, and not before, the American citizen is entitled to full voting privileges. In the light of researches in child development and experience with in-school and out-of-school youth, *voting for all persons at age eighteen is clearly indicated.* By that age, most persons have finished school and are meeting real economic and social responsibilities. Their intelligence, energy, and sense of participation adequately counterbalance the wisdom and life-experience of voting citizens in the later decades. Moreover by voting, they might learn what voting means. Their interests, if specialized at all, would be attached to the needs and problems of youth, and that would be all to the good.

However no *means* test, short of a legal verdict of incompetence, should be attached to the eighteen-year-old voter: as for the twenty-one-year-old, *any* such test, except the purely chronological, would lead to an unreasonable loss of suffrage; it simply could not be well administered. What we establish, with a fixed age, is a *presumption*, a *likelihood*, a *preponderance of general evidence* — whether it be for the age of consent, marriage, confirmation, suffrage, or candidacy. The fairness inherent in the nonparticularity of a specified age, in the long run overrides the obvious incongruities that arise from individual differences. For American life in the middle of the twentieth century, to deny the franchise until age twenty-one is to hold back persons who are capable of assuming social and political responsibilities. There is no magic power in twenty or nineteen or eighteen, but the last figure represents a young person farther along (thanks to science, education, and democratic procedures) than the twenty-one-year-old of the preceding century. In physique, intelligence, vocational fitness, and social insight, youth in its late teens, if provided fully with the opportunities sketched in this volume, would constitute a red-blooded, high-minded addition to the country's political power — a shot in the veins that will be needed in the days to come. The young person just out of school is observant. He has been bossed and disregarded; he has been treated as a child — right up to the time a machine gun is placed in his hands. He can see as well as anybody else that the danger to democracy lies in submission to the polarized will of the inherently dictatorial person whose love of freedom is for himself alone. When nobody is alert, the gangster takes over; when nobody cares, ruthlessness prevails — these are lessons not too hard for youth.

The educational administrator is not immune to the bug of dictatorship. While teachers debate and students run like salmon in the streams, he goes into action. In university circles, it is not uncommon for student body and staff to continue the innocuous discussion of "vital issues," issues already decided, feet on high in the dark recesses of the fixing room — a lesson in democratic procedure taught by men who regard it as a sign of weakness.

As we look beyond World War II, it is clear that America's place in reconstruction will be dominant; therein lies the hope of world-wide security and cultural progress. In this exalted role, alliances with countries, large and small, will require, in principle, nothing more than the merging of two great concepts — *science* and *democracy*. For this magnificent merger, the American spirit is peculiarly fitted. Science ranges from the discovery of tools and methods that guarantee man's survival to the subtle interplay of personal and cooperative forces; democracy, broadly conceived, includes within its conceptual boundaries the full force and flavor of personal, ethical, and spiritual idealism.

The scientific mind is self-cleansing; it has no dead past. To the extent that an individual worker partakes of the spirit of science, he has small capacity to enlist emotional prejudice; he will reject the unsupported pronouncements of a publicized sage, in favor of the latest observed facts of an obscure graduate student.

In the failure to recognize this fundamental principle, we endanger the integrity of the whole pattern of thought. For example, debate as it is sometimes practiced in schools and colleges is a kind of intellectual dumbbell: great wads of cellular material are presented by the opponents, with a very slim connection between them. Such activity has the external appearance of thinking and discussing, but it is composed of dogmatic ingredients that are far removed from the scientific temper. Since the nonscientific branches in school and college occupy so much of the curriculum and of the extracurricular program, it is important that they be kept free from costly errors in procedure and methodology. What is needed in any debate, discussion, panel, or argument is a full revelation of the facts and relations on both sides of an issue: at this point, the phenomenon of integration can take place without regard to personal views.

EDUCATION AND SOCIETY

In education and the humanities, authority unchecked by scientific tests or human experience may lead thousands of potentially brilliant mentalities down the path of confusion and disaster. Anybody who has caught a ride on a vehicle of superstition, propaganda, or authoritarianism can rarely be pushed gently aside; until something drastic is done, he enjoys the irresponsible spree.

To state a problem is not to solve it, and the solution will involve more than speeches and morality plays. We must look resolutely to our mental structure in order to estimate what load the traffic can bear. How much mystery, prejudice, and error can be carried in a world of fallible human beings if mentality-in-action, our sharpest defensive weapon, is to be kept strong? Almost any animal can eat, carry on a social life, and reproduce itself down through countless generations. At these basic-action levels the human race is something of a neophyte. If that is all there is to it, we should take off our hats to the bumblebee. The final test in human values comes in the creation of minds capable of reaching the highest peaks and of holding them through the longest stretch of years. Each person must be regarded as a potent singularity who is also a unit in a complex society.

Practically, this means that we shall place no deterrents whatever upon the inquiring scientific mind. Rather the reverse: we shall give it scope in areas that have been long preempted under such banners as law, politics, and religion. It is not that the free scientist will discover that all human problems are amenable to scientific treatment, or that he may be successful in nonphysical, nonbiological areas, but rather that no other course of action is so richly promising.

If in human behavior, for example, he perceives margins beyond the reach of available data or methods, he can have recourse to whatever methods of observation and experience lie within the framework of the social studies: he will make inferences less solid than those in familiar territory, but they will be better than any deriving an authority from mysterious sources. For one thing, he will know better where to draw the line between the known and the unknown, thus removing one of our principal shortcomings — the tendency to fail in a personal or social problem without ever having tried an appropriate method of attack. Before the advent of modern psychology and sociology, many matters amenable to understanding and control were relegated to the limbo of the predetermined.

If happiness is a worthy human goal, workers, using methods already available in experiment, testing, and clinical procedure, can seek an understanding of its sources. Then, and then only, can we afford to give a free hand to the arts, philosophies, and religions; the artist and the humanist must walk with truth, even the very humble truth of the scientist, before they can approach the limits of their special powers. It is, of course, a mistake to look upon a particular scientist, working in some narrow field, as the exact prototype of the worker here envisaged, although he may be getting insights into problems that baffled the best minds of all the centuries except our own: his lifework is barren only if unrelated to a grand pattern. There are individual scientists who get themselves into eddies, but it would be easy to cite cases of premature diagnosis in this respect — they are not engaged in futility or irrelevance simply because we think so at a given time. What is maintained is a batting average: in every major contest to date the scientist has come out on top.

It may be said that everybody knows this, and what about it? In a restricted sense, we all do know it, but our acceptance is confined to areas largely below biology. To the men who have shed remarkable light on the structural components of the universe, we concede no special insight into personal or social problems; we are ready with good case illustrations. Mr. ——, the renowned physicist, obviously cannot (at least, does not) understand women, children, business, industry, politics, philosophy, or religion! If his scientific method is so good, why is he not a superior mortal in all these respects?

Unfortunately the scientist, in going outside his special subject matter, rarely accepts the validity of his own technique; at times he is loath to recognize a comrade-in-arms, much less a worker in another department of knowledge. A mathematician raises his children neither by the calculus nor by the knowledge and procedures available in child psychology. His discourses on world events may not be superior to those of well-informed high-school students. He would rather plead ignorance in his own field — it would soon be discovered anyway — than admit his ignorance of matters that signify general mental alertness. That he will swallow all kinds of fairy tales, if clothed in the sweetness and light of his own childhood, can be so easily demonstrated as to be scarcely worth mentioning.

In short, the scientist, like everybody else, forgets to use the good light that he has kindled, a light that would brighten his personal, social, and religious life. If pressed for a resolution of mental inconsistencies, he will take refuge in a position that he believes to be at once good mental hygiene and serene pragmatism. He does not want to abandon beliefs that have sustained him thus far, nor interfere with the loyalties of his family and circle of friends. While the American family could be deflected toward scientific habits without much danger of legal or other interference, this would not be true of customs and social services that have long been professionally administered. Irrationality and blind conformance become vested interests serving the cultivated needs of large sectors of the population.

Human intelligence, viewed without personification as a social contract for the betterment of mankind, must take the responsibility for its great discoveries and for its predatory ways. They all stem from the same source; they draw upon the same potentialities of individual cunning and organizational skill. Man has to be ingenious, either to save or to destroy. The desire for war becomes a kind of mental prostitution carried out with tremendous energy and with a singleness of goal that almost certainly becomes pathological. It permits the acceptance of every step and condition leading to a war of conquest, the hope of peace being maintained precariously by the speed of enemy capitulation. Soon every choice becomes deadly: what is left for individual and social intelligence is the grim necessity of achieving victory at all costs.

In this ancient cycle, human achievements are usually threefold — intellectual, social, and emotional. We demand (1) an upward push in the design, production, and utilization of machines (this, in turn, implying an all-out effort in the physical sciences), (2) the strengthening of social bonds, of national unity in the face of a common enemy, and (3) the development of a fatalistic attitude toward injury and death.

The power of machines is tremendous. We have devoted to their development the cumulative ideas of great minds and master craftsmen, freed from all taint of dogma or superstition. Machines are the acme of man's ingenuity and dexterity; they flourish as naturally as well-fed trees. The contrast in the social and political sciences is profound and dangerous; ideologies pointing backward to primitive and deadly behavior patterns are forced upon unwilling minds — if necessary, with the stupendous power of a militarized, mechanized, all-demanding state.

But machines alone cannot save man, nor ensure his progress. Nature recognizes one life force only — the ability to survive. It matters little to anyone but ourselves if the land be populated by stones, plants, reptiles, insects, or men. A persistent social discontent resulting in large-scale destruction, together with a reduced effectiveness against disease (through the neglect of biology), will endanger man's dominant position. Such a fate has overcome other species. Man himself has survived less by successful regional adaptation to malnutrition, disease, or infertility, than by turning to frontiers that had escaped disaster. With the world grown small, everybody is exposed to every disease, physical or cultural. The possibility, however remote, of a general catastrophe is not rejected by the twentieth-century scientist.

Man is the one earthly animal that poses the riddle of its own existence. This is the supreme abstraction: out of the seething cauldron of forces and materials over the ages, how has life come to be, and with it that form of life at first guided by, and now subservient to, the cerebral cortex? The building of a bridge from the inorganic to the organic waits upon man's ingenuity in abstraction and experimentation; it is of one piece with what the biochemical scientist has already accomplished. In nature this is an old thing accomplished many times and perhaps contemporaneously.

To the physical scientist there is nothing inert, nothing dead, but only changed forms, systems, and relationships among energy patterns. If we knew more, very much more, *along exactly the same lines as present-day science,* we could synthesize plants and animals, including the mechanism of heredity, remarkably in accordance with fortuitously appearing forms. To do this we must achieve more than a mastery over the molecule, the cell, and the gene — we must understand and direct potent social forces. We must, in short, abandon forever the attempt to come to terms with life along lines that are primitive, mystical, and irrational. There is ample evidence — a few pinches of it in this volume — that the full understanding of man as a social being need not wait upon remote and dramatic biological events. The raw materials of life are good; they are plastic and tremendously varied. The problem of the times is to work steadily toward their preservation and enrichment.

APPENDIX

THE CONTENT OF BINET TESTS

	Binet and Simon			*Stanford Revision*	*Herring Revision*	*Kuhlmann Revision*	*Stanford Revision 1937*		*Kuhlmann Revision*
	1905	*1908*	*1911*	*1916*	*1922*	*1922*	*L*	*M*	*1939*
Tests for infants [1]									
Co-ordination of movements of vision	x		0–3			0–3			
Wink at object threatening eyes						0–3			
Reaction to sudden sound	x		0–9			0–3			
Turn head toward source of sound						0–6			0–5
Turn eyes toward source of light						0–3			
Postural control:									
Sitting with support						0–6			0–4
Sitting unsupported						0–6 and 1			0–6
Creep or move in some manner									0–9
Pull self to standing									0–11
Stand unsupported						1			1–1
Walk without aid			2						
Prehension provoked by tactile stimulus (hand to mouth)	x		0–9			0–3			
Prehension provoked by visual perception	x		0–9			0–6			0–5
Prolonged holding of object placed in hand						0–6			
Oppose thumb in grasping						0–6			
Pick up checker — thumb and finger									0–6
Remove cover hiding object									0–7
Drop object to take another									0–8

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[1] The infant tests in Binet 1911 (tests below the age of three years) are not usually attached to the scale. They were published in *Les Idées Modernes Sur Les Enfants.*

	Binet and Simon			Stanford Revision 1916	Herring Revision 1922	Kuhlmann Revision 1922	Stanford Revision 1937		Kuhlmann Revision 1939
	1905	1908	1911				L	M	
Tests for infants (*Continued*)									
Drop object for play									0–9
Mark with pencil						1			0–11
Put stick into tube									1–2
Remove marble from bottle									1–2
Put on hat									1–5
Spit out solids						1–6			
Feed with spoon or fork						1–6			
Drink from glass						1–6			
Indicate own natural needs			2						
Recognition of objects — show discrimination or preference						1			
Recognition of objects in pictures (gaze or vocalize)						1–6			
Recognition of food	x		1						
Unwrap paper from candy	x								
Unwrap object						2			
Imitation:									1–3
Shake rattle in any way						1			0–8
Pat-a-cake; bye-bye									0–10
Simple gestures (clap hands, etc.)	x		2			2			
Commands:									
Give up object on command									0–11
Execute simple commands (shut door, throw ball, etc.)	x		2			2			1–4
Give me kitty; put spoon in cup, etc.							2; 3–6	2–6	

Speech:								
Frequently combines 2 or 3 syllables or tries to repeat syllables or words					1			1
Says word								1–3
Uses some words or understands question					1–6			
Combines 2 or 3 words						2	2	
Combines 4 words								2–1
Identifying various things								
Parts of body: Point to on self, on picture or doll	x	3	3	3	x	3	2; 2–6	2	1–6 up
Objects: Give cup, key, etc.	x								
Objects attached to card: Point							2; 2–6	2	
Objects in pictures: Show window, etc.	x					2			1–6 up
Objects by use: What we cook on, etc.									
Small object attached to card							2–6; 3–6	2–6; 3	
Picture							4; 4–6	4	3 up
Right-left: Show left hand, etc.		6	7	6		6			
Naming various things									
Familiar objects or in miniature: key, penny, etc.		4	4	3	x	3	2–6	2; 2–6;3	1-8 up
Object from picture of it	x						2;2–6;3; 3–6; 4	2;2–6;3; 4; 5	1–10
4 colors		8	7	5		5			
Black, gray and white					x				
4 common coins		7		6		7			
6 coins				8					
9 coins		10	9						
Description									
Present picture: "Tell me about it."									
Level 1. Enumeration		3	3	3	x	3	3–6	3–6	2–4 up
Level 2. Description		7	7	7	x	7		6	

	Binet and Simon			*Stanford Revision 1916*	*Herring Revision 1922*	*Kuhlmann Revision 1922*	*Stanford Revision 1937*		*Kuhlmann Revision 1939*
	1905	*1908*	*1911*				*L*	*M*	
Items of information									
Family name		3	3	3		3			
Sex: "Are you a boy or girl?"		4	4	3		4			
Age		6		5					
Number of fingers, each hand and both, without counting		7		7		7		7	
Is it morning or afternoon?		6	6	6		6			
Give days of week		9		7				8	
Give months of year		10	9	9					
Complete information regarding date		9	8	9		9			
Materials: "What is a chair made of?" etc.							4–6	4–6	
Picture of boy, hen, dog: Which runs fastest? etc.									3–9 up
Orientation: Direction. Face in what direction so left hand toward east?							14	14, AA[1]	
Number picture to show correct sequence of events									8–6 up
Resist suggestion									
Designation of objects: Show me button (none there)	x								
Designation of parts of picture: Where is patapoum?	x								
Lines: 3 unequal pairs, 1 equal, which longer	x								
Lines: 3 unequal pairs, longer on right; then 3 equal pairs			12						

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[1] AA, Average Adult.

Definitions, words, sentences									
Definition:									
Level 1. Use	x	6	6	5		5	5	4–6	3–10 up
Level 2. Superior to use	x	9	9	8		9			
Abstract terms		11	12	12	x	11	11; 12; 14	10; 11; 12; 13; 14; AA	
Difference between abstract terms	x	13	adult	AA			AA		
Extensive vocabulary list				8; 10; 12; 14; AA; SA[1]		8	6; 8; 10; 12; 14; AA; SAI; SAII; SAIII		6–2 up
Comprehension of prepositions: block *on* chair, *under*, *behind*, *in front*									2–3 up
Find rhyme(s) for given word	x	12	15	9	x			9	
Find word of certain classification to rhyme with given word: Name a color that rhymes with *head*							9		
Word naming:									
60 in 3 minutes		11	12	10					
28 in 1 minute							10		
Animals, 12 in 1 minute								10	
Use 3 words in 2 sentences		10	10						
Use 3 words in 1 sentence	x	11	12	9	x	9	SAI	7; SAI	
Sentence completion: Series of complete sentences with same meaning — sentence which generalizes this meaning to be completed					x				

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[1] SA, Superior Adult.

	Binet and Simon			Stanford Revision	Herring Revision	Kuhlmann Revision	Stanford Revision 1937		Kuhlmann Revision
	1905	1908	1911	1916	1922	1922	L	M	1939
Definitions, words, sentences (Continued)									
Place disarranged words in order		11	12	12	x	11	13	9; 13	
Finding extra word among disarranged words of sentence									10–3 up
Spell familiar words backwards						10; 12			
Motor co-ordination									
String beads							3	2–6; 4	
Build with blocks:									
2 to 4 block tower							2		1–3; 1–4
3 to 6 block pyramid							3	3	2–5; 3–9
Button 4 buttons									2–10
Turn egg beater								2–6	
Touch each finger with thumb									3–2
Cut with scissors									2–2
Cut irregular form with scissors									4–1
Tie knot							5	5	
Tie bow knot				7					
Trace: square						3			4 up
irregular forms						4			4–7 up
Copying and Writing									
Copy: (some with pen, some with pencil)									
Vertical line								3	
Horizontal line									2
Cross							3–6		
Circle						2	3		1–7
Square		5	5	4		5	5		5–2

Diamond	7	6	7		7	7	
Lines in a square							5 up
Lines in a dot pattern							6 up;
Groups of dots in circle							7–2 up
From a written model:							6–5 up
"The Little Paul"	7						
Write from dictation	8		8				
Following directions							
Put finger to cover small x in small circle				x			
Put finger in diamond and oval, but not in rectangle				x			
Draw triangle on square according to directions					13–15		10–5 up
Draw square on triangle according to directions							12–2 up
Draw square on circle according to directions					9		
Draw lines from center of square according to directions					8		5–10 up
Draw line under scissors and make a dot under the dog, etc.							4–10 up
Locating sections of divided square from description:					12; 13–15		11–5 up
Dividing square into 2 or more special forms with 2 or 3 lines							9–5 up
Following directions in a confusing text					12; 13–15		11–8 up
Cross out Q, R, S, T in pied text					10; 11; 12		
Cross out E, N, R, V in pied text							7–7 up
Cross out all letters except certain ones							6–11 up; 8 up
Find word among 4 without letter common to other 3							9–3 up

	Binet and Simon			*Stanford Revision*	*Herring Revision*	*Kuhlmann Revision*	*Stanford Revision 1937*		*Kuhlmann Revision*
	1905	*1908*	*1911*	*1916*	*1922*	*1922*	*L*	*M*	*1939*
Following directions **(*Continued*)**									
Find letter from order in alphabet: (example: 2nd letter before F, etc.)									8–6 up
Count off and mark dots according to direction									8–4 up
Immediate memory									
Execute 3 simultaneous commands		6	7	5	x	6	4–6		
Delayed response: Put toy under 1 of 3 boxes; count aloud to 10; "Now find the kitty"								2	
Immediate memory of pictures, etc. Look at picture; tell names of objects when it is removed, as above; then look again	x								
Count 2nd recall									5–8 up
3 pictures; take one away; tell which one removed						3			3–5 up
4 pictures; take one away; tell which one removed						4			4–5
2 or 3 objects; tell which was covered or removed							4		2–6 up
See picture of object; remove; find object on card with it and number of other objects							3		
Forms: show form; remove; find it among 16 other forms						4			4–3 up

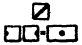
Immediate verbal repetition:									
Series of digits		3 4 7 12	3 4 8 15	3; 4; 7 SA; 10; 14	x	3 4 7	2–6; 3; 4–6; 7; 10; SAII; SAIII	2–6; 3; 4–6; 10; SAII; SAIII	2–2 5–1 up
Digits reversed				7; 9; 12; AA; SA	x	7 9	9; 12; SAI	7; 9; 12; SAI	6–2 up
Sentences	x	3; 5; 6; 12	3; 5; 15	3; 4; 6; 10; AA	x	3 5 11	4; 5; 8; 11; AA	4; 7; 11; 13; SAIII	2–9 up 3–11 up
Series of words							13		
Immediate memory for designs	x		10	10		10	9; 11	9; 12	
Immediate memory of lines on square									8–4 up
Immediate memory of lines on circle						11; 12; 13–15			9–10 up
Immediate memory of bead chain design							6; 13	6; 11	
Immediate memory for selection read		8; 9		10			10		
Immediate memory for selection read, answer questions about							8	10; 13	
Immediate memory for selection read, reproduce thought			adult	SA	x		SAII	SAII; SAIII	
Immediate memory: tap blocks in irregular order						5; 6			4–2; 5–2 up
Immediate memory: fold paper in certain way						6; 8	5		1–11 4–7 up 6–3 up

	Binet and Simon			*Stanford Revision 1916*	*Herring Revision 1922*	*Kuhlmann Revision 1922*	*Stanford Revision 1937*		*Kuhlmann Revision 1939*
	1905	*1908*	*1911*				*L*	*M*	
Comparisons, similarities, differences, classification									
Size comparisons:									
2 lines	x	4	4	4		4			
2 sticks							3–6		
2 spheres (pictures)								3–6	
Squares, triangles, circles					x				
Weight:									
Comparison of 2	x	5	5	5		5			
Arrange 5 weights in order	x	9	10	9		9			
Find gap in weights (1 of 5 taken away)	x								
Aesthetic comparison:									
Which is prettier?		6	6	5	x	6	4–6		
Which is liked best?									3–3 up
Differences and similarities:									
Pictorial: Put finger on one not the same as others							4–6; 6		
Three-hole form board							2	2	
Three-hole form board, rotated							2–6; 3	3	
Pictures: "Are they alike?"								5	
Pictures: "Find one like this."								3–6; 4; 4–6	3–6 up
Forms: "Find one like this."				4	x	4	4		3–1 up
Sort buttons (black and white)							3–6		
Difference: Fly and butterfly, etc.	x	8	8	7		7		6	5–8 up
Similarity: 2 to 4 things, as poppy and blood; fly, ant, butterfly, flea	x			8; 12	x	8	7; 11	8; 11	

Similarity and difference: Baseball and orange				8 SAI	9 SAI	
Essential similarity						
3 principal differences: king and president	adult	14				
Essential difference					AA; SAII	
Opposites:						
Word opposites: Cold, up, etc.			7; 8; 10; 11; 12; 13–15			7–5 up 9–10 up
Opposite analogies: Brother is a boy; sister is a ____. . . . heterogeneous; . . . ____				4–6; 7; SAIII	4; 6; 8; AA; SAI; SAIII	
Reconciliation of opposites: In what way are heavy and light alike?				AA; SAII	14; SAI	
Classification (similarities):						
Find 3 (among 7) words belonging to a class						8–8 up
Picture of 3 vegetables and picture of 1 vegetable and 4 other objects: Which belongs with first three?						5–5 up
Identify the one word among 5 not belonging with the others						8–10 up
Recognition of extra item in group (pictures)						4–4 up
Find term among 5 words that classifies the first of the 5.						10–8 up
Properties:						
Find 2 among 6 that first item is never without						11–2 up
Analogies:						
Find word among 6 that completes analogy						8–8 up
Supply 2 or 4 terms to complete analogy						11–11 up

	Binet and Simon			Stanford Revision 1916	Herring Revision 1922	Kuhlmann Revision 1922	Stanford Revision 1937		Kuhlmann Revision 1939
	1905	1908	1911				L	M	
Numbers, arithmetic problems, counting									
Count aloud:									
4 sous (pennies)		5	5	4		5			
4 blocks, 4 beads, and 4 pennies							5		
9 sous (3 single, 3 double); 9 stamps (3 1¢ and 3 2¢)		8	7	9		8			
13 single sous		7	6	6				6	
From 20 to 0 (or 1)		8	8	8		8			
Number concepts:									
Concept of 2								4	
Concept of 3								5	
"Give me ___ blocks"							6	6	
Match number of objects (1 block, 4, etc.)								3–6	
Count to self:									
Regular series of taps								7	
Irregular series of taps						6; 10			5–6 up
Groups of dots						8; 9; 10			6–8 up
Blocks in piles (pictures)								10	
Making change with money (4 out of 20 sous)		9	9						
Change not using money: 4 out of 10¢, 12 out of 15¢, etc.				9		9	9		
Simple arithmetic problems						11; 12; 13–15			
Arithmetical reasoning ($20 a week; spends $14; how long to save $300, etc.)				14			AA		
Finding middle number among 5 (get median)									9 up
Complete last 2 numbers in series (9, 8, 7, 6, —; 0, 2, 8, 26, —)					x				

Series (tree 8 inches tall; end of 1st year 12 inches, etc.)							SAIII		
Series (fill blanks: roast 1 lb. meat —, roast 2 lbs. meat ¾ hour, etc.)					x				
Find number not belonging to series									10–11 up
Induction test: Fold paper once, cut 1 hole; fold paper again, cut 2 holes, etc. Find rule.				14			14		
Abstract questions, interpretation, inference									
Comprehension question, abstract question									
Series, various levels, what to do when sleepy, when miss train, why judge by acts (not words)	x	10	9 10	4; 6; 8; 10	x	4	3–6; 4; 7; 8	3–6; 4–6; 5	2–7 up
Finding reasons (why children should not be noisy; why plenty of railroads in U. S.)							10; SAII	11	
Interpretation of:									
Fables				12; AA					
Proverbs					x		AA; SAII	AA; SAII SAIII	
Group of sayings with same meaning					x				
Picture description. Level 3: Interpretation		12	15	12	x		12	6; 17	
Problems of various facts (visitors: doctor, lawyer, priest; what was happening? etc.)		12	12	14	x		11; 13	8; 13	
Criticism of absurdities									
Sentences		11	10	10	x	10	8; 9; 11; 12	8; 9; 10; 11	
Pictures							7; 10; 14	7; 12; 14	
Comprehensions of physical relations (path of cannon ball, etc.)				AA					

	Binet and Simon			Stanford Revision 1916	Herring Revision 1922	Kuhlmann Revision 1922	Stanford Revision 1937		Kuhlmann Revision 1939
	1905	1908	1911				L	M	
Abstract questions, interpretation, inference (Continued)									
Comprehension: "Who is referent of 'he' in 2 lines of poetry?"					x				
Making logical inferences (if number A is B and all C is A; 4 conclusions, choose correct one)						13–15			
Problems: Figure out time of event on basis of certain information					x			14	
Miscellaneous items: largely problems and puzzles									
Picture completion									
Unfinished pictures: tell what is missing		7	8	6		6	6	5	3–7 up
Picture completion: (drawing)									
Man							4; 5		
Bird								4–6	
Puzzles									
Game of patience: 		5	5	5		5		5	4–5
Construction puzzle:				10					
Codes:									
Write in code from memory of system				AA	x				
Figure out system and write word							AA	AA; SAII	

Write letters corresponding to numbers given: AEBHRT 1 2 3 4 5 6 3–1–6 = ?								8 up
Give associated numbers for dissected parts of simple form					10; 11; 12			9 up
Problems								
Paper cutting (Fold, cut; What would it look like unfolded?)	x	13	adult	SA		9; 13; SAIII	AA	
If cube cut in certain way: Number of pieces; number of painted and unpainted sides								10 up
Reversal of hands of clock	x			14				
Reversed triangle: Draw figure if triangle half of rectangle were turned over		13	adult					
Draw upright forms in inverted position					13–15			12–6 up
Draw shortest path:								
To school						6		
For news route				x				
Enclosed box problem				AA		SAI		
Problems:								
(go 5 blocks W, 3 S, 4 E, 1 S, 1 E. How far from start? Etc.)					x			
As above, plus, "What direction will you be going?"						SAIII 13	SAIII 13	
Ball and field: ○•◇				8; 12				
Ingenuity (Measure 7 pints with 3 and 5 pint vessels, etc.)				SA		14; AA	14; AA; SAII	

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